Central Valley Project Improvement Act

Draft Programmatic Environmental Impact Statement

US Department of the Interior

Bureau of Reclamation

Sacramento, California

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LIST OF TECHNICAL APPENDICES
(SEPTEMBER 1997)

VOLUME ONE	Development of the No-Action Alternative Summary of Pre-CVPIA Conditions Evaluation of Preliminary Alternatives Public Involvement
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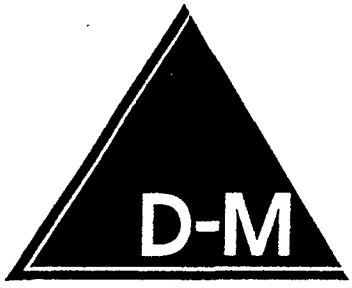

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CENTRAL VALLEY PROJECT IMPROVEMENT ACT
PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

DRAFT TECHNICAL APPENDIX

Visual Resources

September 1997

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LIST OF ABBREVIATIONS AND ACRONYMS

BLM	U.S. Bureau of Land Management
Caltrans	California Department of Transportation
COE	U.S. Army Corps of Engineers
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
Delta	Sacramento-San Joaquin Delta
FLPMA	Federal Land Policy and Management Act of 1976
NEPA	National Environmental Policy Act of 1969
OPR	California Office of Planning and Research
PEIS	Programmatic Environmental Impact Statement
Reclamation	U.S. Bureau of Reclamation
SWP	State Water Project
USDI	U.S. Department of the Interior
USFS	U.S. Forest Service
VRM	Visual Resource Management
VMS	Visual Management System

CHAPTER I

INTRODUCTION

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Chapter I

INTRODUCTION

The Draft Programmatic Environmental Impact Statement (PEIS) summarizes the evaluation of the direct and indirect impacts of implementing a wide range of actions identified in the Central Valley Project Improvement Act (CVPIA). Details of the information used in the definition of the affected environment and analysis of the environmental consequences are presented in the technical appendices of the Draft PEIS.

This technical appendix presents a summary of visual resources background information that was used during the PEIS preparation, and the results of the impact analyses for conditions that occurred throughout the study area, shown in Figure I-1.

The visual resources analysis was primarily based upon changes in land use, primarily agricultural land use, and changes in water levels at reservoirs and rivers. Information from the Agricultural Economics and Land Use and the Surface Water and Facilities Operations technical appendices was used in the visual resource analyses.

The assumptions and results of the analyses for Alternatives 1, 2, 3, and 4 are presented in this technical appendix and summarized in the Draft PEIS. The assumptions and results of Supplemental Analyses 1a through 1i, 2a through 2d, 3a, and 4a are summarized only in the Draft PEIS. The assumptions related to the visual resources analyses for Alternatives 1, 2, 3, and 4 are presented in Table I-1. The results of the analyses are presented in Table I-2.

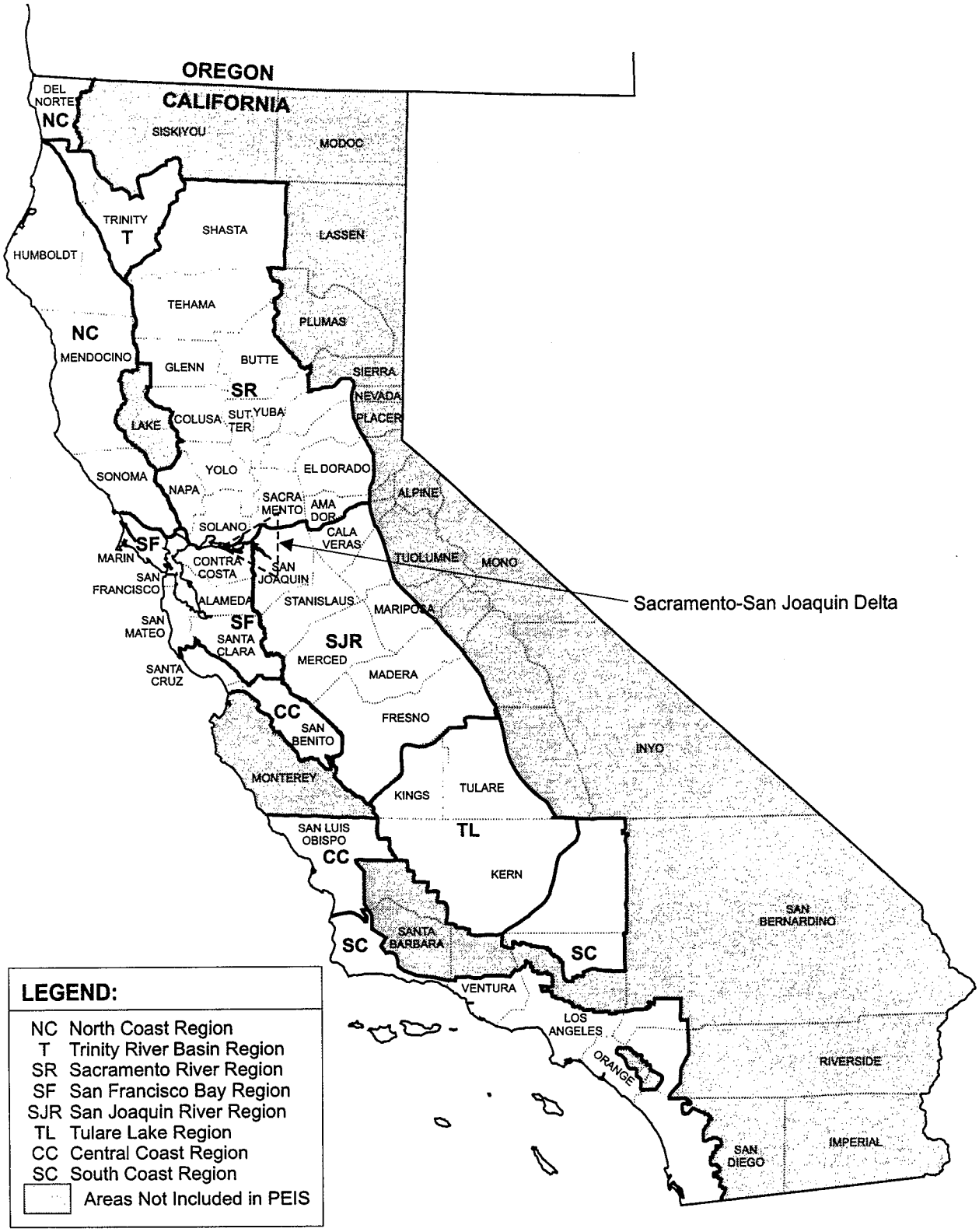

FIGURE I-1
STUDY AREA

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TABLE I-1

SUMMARY OF ASSUMPTIONS FOR VISUAL RESOURCES ANALYSES

Alternative or Supplemental Analysis	Assumption
No-Action Alternative	Municipal, agricultural, and recreational land uses as described in California Department of Water Resources Bulletin 160-93.
1	Changes in cultivated acreage and reservoir water elevations are primary factors that would affect visual resources.
2	Same as Alternative 1.
3	Same as Alternative 1.
4	Same as Alternative 1.

TABLE I-2

SUMMARY OF IMPACT ASSESSMENT OF VISUAL RESOURCES

Affected Factors	No-Action Alternative	Alternative 1	Alternative 2	Alternative 3	Alternative 4
		Change from No-Action Alternative			
Regional Visual Resources	Similar to existing conditions	Similar to No-Action Alternative	Similar to No-Action Alternative	Similar to No-Action Alternative	Similar to No-Action Alternative

CHAPTER II
AFFECTED ENVIRONMENT

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Chapter II

AFFECTED ENVIRONMENT

INTRODUCTION

This technical appendix focuses on the Central Valley (the Sacramento River, the San Joaquin River, and the Tulare Lake regions) and the nearby mountains in which the CVP reservoirs are located. The following sections describe provinces associated with each region, the variety classes in each province, and the historical perspective and recent conditions of the landscape features within each region. In addition, information is presented on designated Wild and Scenic Rivers and scenic highways located within the PEIS study area.

The study period for visual resources extends from the 1940s to 1992, focusing on recent visual conditions because little information is available on historic visual landscapes.

DATA SOURCES

Information on visual resources was derived from a variety of sources. Visual Management System (VMS) classifications were obtained from U. S. Forest Service (USFS) documents. Information on designated Wild and Scenic Rivers was taken from publications prepared by the USFS and U.S. Department of the Interior (USDI). Information on designated and eligible state and county scenic highways came from publications of the California Department of Transportation (Caltrans).

The data collection focused on compiling inventories for two primary considerations: (1) the general visual resources of landscapes in which existing CVP facilities are located, including dams, reservoirs, and aqueducts; and (2) visual resources within the broader general study area in which undefined visual impacts could occur. The immense size of the PEIS study area necessitates this generalized "broad brush" approach.

Inventories of landscapes and visual quality, where available, are limited to national forests because the VMS was developed for application in those areas. Large portions of California have not been inventoried for management of visual resources. For this reason, the assessment of landscapes in this technical appendix is, in part, based on an application of VMS to the Central Valley, urban areas, and rural areas not within USFS jurisdiction.

Landscape character types described are based on State of California Natural Landscape Provinces (USFS, 1976), and are represented by seven immense provinces with similar physiographies, that is, combinations of landform, vegetation cover, and surface water bodies. A province's landscape character types are based on its total visual character; no single physical characteristic dictates character type, although landform has a stronger influence than other

characteristics. The provinces, and their corresponding landscape character types, do not correspond with the study area regions used for this technical appendix; therefore, landscape character types have been interpolated from the USFS 1976 report to conform to the study area subregions.

HISTORICAL PERSPECTIVE

The construction of the CVP, SWP, and numerous local water projects has substantially altered land use in the PEIS study area. In addition, post-World War II urbanization and major highway construction projects have significantly altered the landscape throughout California. A reconstruction of the historical visual landscape would offer little useful information at the broad scale of this investigation. From the standpoint of visual resource assessment, there is little incentive in most ongoing geographically broad visual resource management plans and programs to return the landscape to its former (pre-World War II) visual state. Where such programs do exist, they are usually carried out in lands managed for preservation (e.g., National Parks and Nature Conservancy lands) or directed to small areas that are beyond the scope of this assessment. Therefore, for each region evaluated in this technical appendix, only a qualitative summary statement is presented regarding the visual landscapes that existed at the time the CVP (and related projects) were constructed.

SACRAMENTO RIVER REGION

Before World War II and before construction of the CVP, the visual landscape of the Sacramento River Region appeared much less altered than it does today. In the 1940s, the valley was largely open grasslands with scattered expanses of oak woodland. Wetlands, vernal pools, and riparian corridors added visual variety to the landscape. Settlement was sparse, with small communities, located primarily along the rivers, and scattered rural ranches. A significantly smaller area of the landscape was irrigated (California Office of Planning and Research [OPR], 1979). Few of the rivers were regulated. Much of the view opportunity was limited to the road and railroad corridors.

After the development of the CVP and the population influx following World War II, rapid agricultural development and the growth of communities changed the visual landscape substantially and relatively quickly. Much of the grassland was replaced by irrigated cropland, rice fields, and orchards. Most of the wetlands, vernal pools, and riparian corridors were eliminated. A more extensive road system was developed, creating more opportunities for public access and landscape viewing from roads, but at the same time altering the landscape.

Construction of dams and reservoirs substantially altered the visual character of the valleys in which the reservoirs were constructed. The reservoirs added visual variety, since large water bodies are widely perceived as features of high visual interest. Additionally, the reservoirs provided significant new view opportunities as they became major recreation facilities. These reservoirs changed the visual character provided by free-flowing streams to landscapes characterized by lake settings. CVP canals also added visual variety to the landscape by their form and water feature qualities. Pump stations and electric transmission lines generally added contrast to the landscape and reduced visual quality.

SACRAMENTO-SAN JOAQUIN DELTA REGION

The Sacramento-San Joaquin Delta (Delta) landscape once consisted of a vast system of wetlands and river channels. The creation of levees, beginning in the 1850s, dramatically changed the visual landscape of the Delta. By 1900, half of the Delta area had been converted to reclaimed tracts, and by 1930 only a small amount of the natural landscape remained. The large expanses of wetlands, riparian corridors, and open water were replaced by agricultural lands in low-lying tracts surrounded by levees. The visual quality was substantially reduced as landscape variety diminished. Roads developed on the levees provided new viewing opportunities. Riparian vegetation remained along the slough edges in many areas or reestablished after levee construction. In some cases, previously reclaimed tracts that were flooded as a result of levee breaks during the floods have not been converted back to agriculture. These tracts of open water add to the visual variety in the Delta today.

The establishment of settlements in the Delta began in the mid-1800s. By the 1940s, the cities of Stockton, Pittsburg, Antioch, and Martinez were the primary settlements and these were small communities at the edges of the Delta. Few roads existed in the Delta, and most viewing opportunities were provided from railroad lines and boats. The visual landscape of the Delta during the 1940s did not differ substantially from that of today, except along its margins. After World War II, the margins of the Delta became sites of expanding urbanization, a process that continues today. The cities of Pittsburg, Antioch, and Martinez have grown into a somewhat contiguous belt of urban development, almost completely altering the visual landscape. Urbanization has continued eastward into Contra Costa County and San Joaquin County in the Brentwood, Discovery Bay, and the Stockton areas.

SAN JOAQUIN RIVER REGION

Before World War II and construction of the CVP and the SWP, the visual landscape of the San Joaquin River Region appeared less altered than it does today. Prior to the 1940s, largely open grasslands with scattered expanses of oak woodland typified the region, with large areas of wetlands, vernal pools, and riparian corridors located throughout, adding visual variety to the landscape. Settlement was sparse and consisted of small rural communities, such as Fresno and Modesto, and scattered rural ranches. Although irrigated land was developed in scattered areas as early as the 1870s in some areas (OPR, 1979), prior to World War II, a significantly smaller area of landscape was irrigated than is today. Much of the view opportunity was limited to road and railroad corridors less extensive than those of today.

After the development of the CVP and the population influx after World War II, rapid agricultural development and the growth of communities changed the visual landscape substantially and relatively quickly. Through the late 1960s, this trend continued in the San Joaquin River Region. As a result, most grassland was replaced by irrigated cropland and orchards, and most of the once extensive wetlands, vernal pools, and riparian corridors were reduced to scattered remnants. A more extensive road system was developed, including expansion of State Route (SR) 99 and construction of Interstate I-5 and several major cross-valley routes, creating more opportunities for public access and landscape viewing from roads, but at the same time altering the landscape.

Construction of dams and reservoirs by the CVP, U.S. Army Corps of Engineers (COE), SWP, and several local water agencies substantially altered the visual character of the valleys in which the reservoirs were constructed. The reservoirs added visual variety, since large water bodies are widely perceived as features of high visual interest. Additionally, the reservoirs provided significant new view opportunities as they became major recreation facilities. These reservoirs changed the visual character provided by free-flowing streams to landscapes characterized by lake settings. The visual landscape was further altered with the construction of vast canal siphons, which carry water throughout the agricultural lands in the region. Pump stations and electric transmission lines generally added contrast to the landscape and reduced visual quality.

TULARE LAKE REGION

The Tulare Lake Region has undergone substantial visual alteration from its natural condition. Until the late 1800s, most of the region consisted of seasonal water bodies and wetlands, grasslands, and saline flats and a few areas of riparian forest. Development of irrigated agriculture began as early as the 1870s, but the most substantial landscape changes resulted from the CVP in the 1940s and the SWP in the late 1960s (OPR, 1979). At the time of CVP construction, conversion of lands to agricultural uses in the eastern part of the region was almost complete. The western part of the region was developed later, and conversion of grasslands to irrigated agriculture was not as extensive as in the eastern part of the region. Rural development occurred in the first half of the twentieth century, and some communities, notably Bakersfield, grew substantially after World War II.

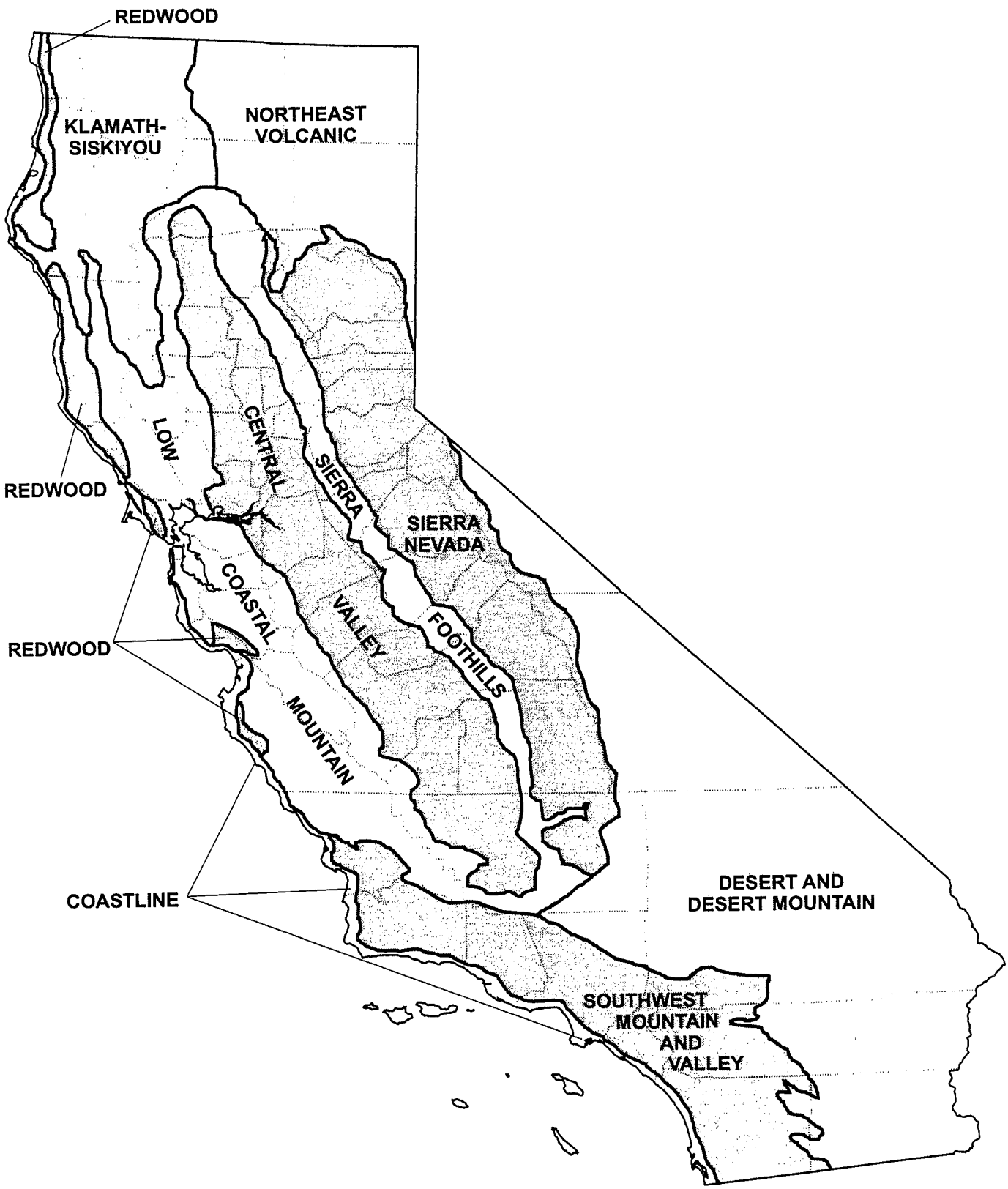
RECENT CONDITIONS

SACRAMENTO RIVER REGION

Introduction

The Sacramento River Region consists of large areas of gentle to flat slope. The northern portion of the region contains broad expanses of grasslands and oak woodlands. Most of the Sacramento Valley has large areas in agricultural production including rice fields, orchards, and row crops. The Sacramento River is the dominant water feature in the region, with numerous tributaries draining from the adjacent mountains to the east and west. Tributaries entering from the east are large and more numerous, because they drain the well-watered slopes of the Sierra Nevada. The drier Coast Ranges on the west side of the valley have fewer streams. Metropolitan Sacramento is the major urban area in the region; moderate-sized urban areas include Redding, Red Bluff, and Chico. Many small communities are scattered throughout the valley. The eastern portion of the region is more urbanized than the western portion.

The Sacramento River Region includes three provinces: the Sierra Foothills and Low Coastal Mountain, Central Valley, and Sierra Nevada (Figure II-1). Characteristics of these provinces and their associated variety classes are summarized in Tables II-1, II-2, and II-3.



SOURCE: U.S. Forest Service, 1976

FIGURE II-1

NATURAL LANDSCAPE PROVINCES

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TABLE II-1

SIERRA FOOTHILLS AND LOW COASTAL MOUNTAIN PROVINCE LANDSCAPE CHARACTERISTICS AND ASSOCIATED VARIETY CLASSES

Province Characteristics	Associated Variety Class Characteristics
Topography is hilly to mountainous, interspersed with plateaus, and dissected by major river canyons. Contains vegetation types somewhat related to altitude; grasslands occur at lower elevations, and oak woodlands, mixed conifers, and brushlands occur as elevations increase. Riparian vegetation is common in the canyons and along watercourses. Large rivers and streams drain the foothills from the Sierra Nevada, and fewer streams drain the Coast Ranges. The province is moderately populated but is widely dispersed in rural communities and low density development. Population has increased markedly in recent years, especially in the Sierra foothills. Numerous small historic communities and mining sites are scattered throughout the region, attracting a large tourist and recreation population.	**A (Distinctive Scenic Quality):** Landforms include (1) sharp peaks and ridges; (2) isolated peaks with distinctive form and color contrast that become focal points; (3) deep canyons and distinctive gorges and valleys having vertical or near vertical walls and unusual configurations and rock color; or (4) large rock outcrops, cliffs, or boulders. Vegetation consists of (1) strongly defined patterns or combinations of coniferous forest, deciduous forest, riparian vegetation, brushland, barren rock and soil, and meadows; (2) dramatic displays of seasonal color; (3) or unusual forms such as gnarled, dwarfed, or unusually large species and vegetation with unusual color, form, and texture when compared to surrounding vegetation. Water features include (1) waterfalls, cascades, rapids, and pools with reflecting qualities; (2) areas with variations in water body types, or areas with unusual shoreline character and channel configurations; or (3) areas with high water clarity and high visibility. **B (Common Scenic Quality):** Landforms include (1) broad slopes that may be steep but stable, with broad valleys and plateaus not dramatically defined by adjacent landforms; (2) rounded hills, ridges, and peaks that lack visual dominance; (3) subordinate lateral canyons lacking distinctive configuration and rock color; or (4) minor rock outcrops, cliffs, and boulders. Vegetation consists of (1) open scattered forest or brush combined with some natural openings and riparian corridors in patterns that offer some visual relief; (2) seasonal color contrast; or (3) stands that exhibit the normal range of sizes, forms, colors, textures, and spacings. Water features include (1) rapids, pools, streams, rivers, and small ponds; (2) common shoreline character and channel configurations; or (3) medium water clarity and moderate visibility. **C (Minimal Scenic Quality):** Landforms vary slightly, and include vast expanses of indistinct terrain that provides little spatial definition or landmarks to which viewers can orient themselves. Slopes may be steep, but lack visual interest and variety. Vegetation is unvaried with extensive areas of similar vegetation and limited variation in color and texture. Water features are (1) lacking or intermittent; and (2) have low water clarity and low visibility so that they are not visually apparent except when in the immediate foreground.

TABLE II-2

CENTRAL VALLEY PROVINCE LANDSCAPE CHARACTERISTICS AND ASSOCIATED VARIETY CLASSES

Province Characteristics	Associated Variety Class Characteristics
Characterized as predominately lowlands and plains with few hills. Mostly agricultural, with areas of wetlands and oaklands. Oak woodlands are located on the margins and northern end of the valley. Riparian areas are located along the major watercourses. Numerous small communities are located throughout the valley.	**A (Distinctive Scenic Quality):** Landforms include (1) isolated peaks with distinctive form and color contrast that become focal points; or (2) massive rock outcrops. Vegetation consists of (1) strongly defined patterns or combinations of riparian vegetation, oak woodlands, wetlands, open grasslands and pastureland, and cropland; or (2) displays of seasonal color. Water features include (1) large rivers with meandering channels and natural edges; (2) large reservoirs; (3) marshes; or (4) large aqueducts. **B (Common Scenic Quality):** Landforms include (1) broad slopes forming broad valleys, flats, basins, and plateaus that are not dramatically defined by adjacent landforms; (2) rounded hills and ridges that are not visually dominant but are surrounded by landforms of similar types; or (3) minor rock outcrops. Vegetation consists of (1) predominant cropland with variation in form, texture, and color common to the region; (2) open oak woodland with some grassland openings that offer some visual relief; or (3) grasslands with stands of oaks that offer some visual relief. Water features consist of (1) small rivers and intermittent streams; or (2) agricultural ponds and drainage/irrigation canals. **C (Minimal Scenic Quality):** Landforms are unvaried, with vast expanses of flat terrain. Vegetation is unvaried with (1) large expanses of agricultural types having similar form, texture, and color; (2) large expanses of brush and grassland; or (3) large expanses of fallow land and barren soil. Water features are absent.

TABLE II-3

SIERRA NEVADA PROVINCE LANDSCAPE CHARACTERISTICS AND ASSOCIATED VARIETY CLASSES

Province Characteristics	Associated Variety Class Characteristics
Characterized topographically as a deeply dissected sloping plateau. Terrain is moderately rugged and dissected by deep valleys and canyons with rushing rivers. Heavily forested, especially with yellow pines, frequently interrupted by brushfields and stands of aspen. The highest areas display numerous jagged and serrated peaks with deep U-shaped canyons. The crest of the range and highest peaks lie east of and outside the Sacramento River Region. Sparsely populated with scattered communities located along major roads, although the population has grown markedly in recent years. The area receives substantial recreational activity, especially in summer.	**A (Distinctive Scenic Quality):** Landforms include (1) sharp peaks and sharply serrated ridges, and unique glacial forms; (2) isolated peaks and domes with distinctive form and color that become focal points; (3) deep canyons and distinctive gorges and valleys with vertical or near vertical walls and unusual configurations and rock color; or (4) massive rock outcrops, cliffs, talus slopes, avalanche chutes, boulders, and groups of boulders. Vegetation consists of (1) strongly defined patterns or combinations of coniferous forest, deciduous forest, riparian vegetation, brushland, barren rock and soil, and meadows; (2) dramatic displays of seasonal color; or (3) vegetation with unusual forms such as gnarled, dwarfed, or unusually large species, and vegetation with unusual color, form, and texture compared to surrounding vegetation. Water features include (1) waterfalls, cascades, rapids, and pools with reflecting qualities; (2) areas with variations in water body types, or areas with unusual shoreline character and channel configurations; (3) areas with high water clarity and high visibility; and (4) hot springs and geothermal vents. **B (Common Scenic Quality):** Landforms include (1) broad slopes that may be steep but stable, with broad valleys not dramatically defined by adjacent landforms; (2) rounded hills, ridges, and peaks that lack visual dominance; (3) subordinate lateral canyons lacking distinctive configuration and rock color; or (4) minor rock outcrops, cliffs, talus slopes, avalanche chutes, boulders, or groups of boulders. Vegetation consists of (1) predominantly forest or brush cover combined with natural openings and riparian corridors in patterns that offer some visual relief; (2) seasonal color contrast; or (3) vegetative stands that exhibit normal range of sizes, forms, colors, textures, and spacings. Water features include (1) rapids and pools, and streams, rivers, and small ponds; (2) common shoreline character and channel configurations; or (3) medium clarity and moderate visibility. **C (Minimal Scenic Quality):** Landforms vary slightly including vast expanses of indistinct terrain that provides little spatial definition or landmarks to which viewers can orient themselves. Slopes may be steep, but lack visual interest and variety. Vegetation is unvaried with extensive areas of similar vegetation and limited variation in color and texture such as stands of lodgepole pine or white fir and brushfields. Water features are (1) lacking or only flowing intermittently; or (2) have low water clarity and low visibility so that they are not visually apparent except when in the immediate foreground.

CVP Facilities in the Sacramento River Region

CVP facilities in the Sierra Foothills Province include major water features and facilities of the American River Division including Folsom Lake and Lake Natoma. Folsom Lake is included within a State Recreation Area and receives heavy visitation. Both lakes are considered Variety Class B, and management standards include retention, partial retention, and preservation.

CVP facilities in the Low Coastal Mountain Province consist of the major water features and facilities of the Shasta Division, including Shasta Lake, Whiskeytown Lake, Keswick Reservoir, and Spring Creek Reservoir. Shasta Lake and Whiskeytown Lake are included in a National Recreation Area. Each of these facilities adds substantially to the character and quality of the visual landscape. Sensitivity is high because some of these reservoirs receive substantial recreational use or are located on well-traveled roads. The area generally is considered Variety Class B and is managed mostly for retention, partial retention, and modification. The area around Shasta Lake and Whiskeytown Lake is considered Variety Class A, with retention and partial retention the primary management standards.

CVP facilities in the Central Valley Province are Black Butte Reservoir, Corning Canal, Tehama-Colusa Canal, Folsom South Canal, water service areas of the CVP, pumping stations, diversions, and power transmission lines. Black Butte Reservoir adds substantially to the local visual quality and receives substantial recreation use. Considered Variety Class B, the reservoir is managed for preservation and retention. The Corning, Tehama-Colusa, and Folsom South canals also add visual interest, although the sensitivity is low because of limited viewing opportunities. The diversion features and power lines add variety to the visual landscape, although these are sometimes regarded as detrimental features. Most of the area is agricultural land with areas of riparian forest and wetlands. The rural area is generally considered Variety Classes B and C, and management standards include modification, maximum modification, and partial retention. Some areas of riparian vegetation and wetlands are included as preserves. Urban areas are considered Variety Class C, and management standards include maximum modification and modification. However, the American River between Folsom Lake and the Sacramento River, including the portion through urban Sacramento, is designated Recreational in the National Wild and Scenic Rivers System. It is considered Variety Class A-B and is managed as a parkland preserve.

Sugar Pine Reservoir and Jenkinson Lake are the CVP facilities in the Sierra Nevada Province. Each of these water bodies adds to the scenic variety and quality of the landscape. Jenkinson Lake receives substantial recreation, and, therefore, has high visual sensitivity. Sugar Pine Reservoir and Jenkinson Lake are considered Variety Class B-A, and management standards include retention, partial retention, and preservation. The North Fork of the American River above Folsom Lake is a designated Wild and Scenic River. It is considered Variety Class A and is managed for preservation.

These CVP facilities have historically been managed for a variety of purposes including flood control, irrigation, and recreation. Management activities include drawing down the reservoirs on a regular basis and releasing water to the rivers. These management activities alter the visual resources of the margins of the affected reservoirs and rivers.

SACRAMENTO-SAN JOAQUIN DELTA REGION

Introduction

The Sacramento-San Joaquin Delta is a vast low-lying flat area; most relief is provided by man-made levees. Most of the area is in agricultural use with rice, truck croplands, and orchards, but areas of wetlands and riparian vegetation are interspersed along the waterways. Some large wetland preserves are located in the region. The region is sparsely populated. The major urban areas include Stockton, located along the eastern edge of the Delta and eastern Contra Costa County along the southern edge of the western Delta. Water-oriented recreation is the major source of visitation.

The Delta is located entirely within the Central Valley Province. Table II-2 describes the landscape characteristics of the Central Valley Province and the associated variety classes.

CVP Facilities in the Sacramento-San Joaquin Delta Region

CVP facilities in the Sacramento-San Joaquin Delta Region include the Delta Cross Channel, the eastern part of the Contra Costa Canal, and Contra Loma Reservoir. These facilities add visual interest to the landscape. The area is predominantly considered Variety Classes B and C, with primary visual interest created by water features. In most areas, visual sensitivity is low; however, because of the emphasis on water-oriented recreation in the Delta, recreation areas have moderate to high visual sensitivity. Except for wetland preserves, most of the area is managed for maximum modification and modification. Contra Loma Reservoir provides recreational facilities managed by the East Bay Regional Park District. It is considered Variety Class B, and the management standard is partial retention and modification. Some of the wetland preserves, including Suisun Marsh, are considered Variety Class A because of their water and vegetation features, as well as their seasonal flower displays and waterfowl.

SAN JOAQUIN RIVER REGION

Introduction

The San Joaquin River Region is lowland with predominantly flat and gently sloping terrain bordered by hills and low mountains. The valley is semi-arid to arid, and few natural lakes or perennial streams are present. The San Joaquin River is the principal water feature, and it receives most of its flow from the Sierra Nevada. A number of wetlands used as wildlife refuges are located in the region. The valley area has been developed primarily for agriculture. It is sparsely-to moderately-populated, having one large urban area (metropolitan Fresno), a number of moderate-sized urban areas along SR 99, and scattered small communities. Along the central-eastern part of the valley, SR 99 is heavily traveled and provides extensive viewing opportunities to a large number of people. The northern area of the region near Tracy is developing rapidly as an extension of the San Francisco Bay Area.

The San Joaquin River Region includes two provinces presented in Figure II-1: the Sierra Foothills and Low Coastal Mountain, and the Central Valley. Landscape characteristics of these provinces and their associated variety classes are summarized in Tables II-1 and II-2.

The Coast Range portion of the region is sparsely populated. It features hilly to mountainous terrain vegetated by grasslands and scattered oak woodlands. Narrow riparian corridors are located in the valleys. The entire area receives little recreation visitation except at a few reservoirs, primarily the San Luis Reservoir State Recreation Area. However, I-5 passes along the edge of the valley at the foot of the Coast Range. This heavily traveled corridor provides extensive viewing opportunities to a large number of people.

The Sierra Foothills portion of the region is sparsely populated, although the population has increased recently, especially toward the northern part of the region. The area is characterized by hilly to mountainous terrain vegetated by grasslands and scattered oak woodlands mixed with conifers. Narrow riparian corridors are located in the valleys. The reservoirs in the foothills receive substantial recreation visitation. Additionally, numerous visitors pass through the region en route to the national parks and national forests.

CVP Facilities in the San Joaquin River Region

The principal facilities in the western portions of the San Joaquin River Region are San Luis Reservoir, O'Neill Forebay, Los Banos and Little Panoche reservoirs, and the Delta-Mendota, San Luis, and Coalinga canals. The CVP also supplies water to several wildlife refuges. Most of the landscape is considered Variety Class B or C for both the Central Valley and Low Coastal Mountain portions. San Luis Reservoir, O'Neill Forebay, and the two smaller reservoirs are considered Variety Class B, and the management standard is retention and partial retention.

The service area of the CVP, including the area of the Delta-Mendota Canal and the nearby California Aqueduct, is considered predominantly Variety Class C, with some areas of Variety Class B. The management standard applied in these areas is maximum modification and modification. I-5 provides panoramic view opportunities in some areas, some segments of which are designated scenic highways. Views of the Delta-Mendota Canal and California Aqueduct are the basis for designation of I-5 as a scenic highway. Similarly, views of San Luis Reservoir are an important part of the designation of SR 152 as a scenic highway.

Wildlife refuges in the region are considered Variety Class B-A. These areas provide visual contrast with surrounding agricultural lands primarily because of their vegetation and water. The scenic quality is also enhanced seasonally by the large numbers and variety of waterfowl and seasonal wildflower displays, which attract substantial visitation, thereby increasing the viewer sensitivity of the area.

Principal CVP facilities in the eastern portions of the San Joaquin River Region include the East Side Division, consisting of New Melones Reservoir, and the Friant Division, consisting of Millerton Lake and the Friant-Kern and Madera canals. Millerton Lake and New Melones Reservoir are in the Sierra Foothills Province. These areas are considered Variety Class B. New Melones Reservoir has a large number of mining sites that detract from its visual quality, and it requires a rehabilitation management standard. Both reservoirs are managed for retention and preservation areas, and both are important recreational facilities; therefore, viewer sensitivity is high.

Unlike the Delta-Mendota Canal, the Friant-Kern Canal and Madera Canal offer relatively few road travel viewing opportunities. The canals enhance the visual interest of the landscapes in which they occur, but the flat land and land uses prevent frequent viewing by travelers on major routes. The service area is predominantly considered Variety Class C, with extensive areas of monotonous landscape. The management standard is maximum modification or modification. Exceptions are those areas where the foothills join the Central Valley to form entrant valleys of agricultural land surrounded by grass-covered and wooded hills, which are considered Variety Class B. The management standard is maximum modification or modification. Urban areas are considered Variety Class C, with management standards of maximum modification and modification.

TULARE LAKE REGION

Introduction

The Tulare Lake Region is predominantly a broad flat lowland, and the landscape is predominantly irrigated agriculture. Four major rivers, the Kings, the Kaweah, the Tule, and the Kern, cross the plain, deriving their flow from runoff in the Sierra Nevada to the east. The flow of each of the rivers is controlled upstream from the Tulare Lake Region. Riparian vegetation occurs along the rivers. Relatively few rivers enter from the west because the Coast Ranges in the area have an arid/semi-arid climate. The principal urban area is Bakersfield, and scattered moderate- and small-sized communities are concentrated in the eastern part of the basin. Oil development near Bakersfield is characteristic of the region.

The Tulare Lake Region includes two provinces: the Sierra Foothills and Low Coastal Mountain and the Central Valley (Figure II-1). Landscape characteristics of these provinces and their associated variety classes are summarized in Tables II-1 and II-2.

The Low Coastal Mountain Province in the Tulare Lake Region consists predominantly of hills vegetated with grass, and is used as range land. Only small riparian stringers are located along watercourses. Some oak woodlands also are present. Part of the landscape in this region has been highly altered by oil development, with substantial visual landscape degradation. The area is sparsely settled.

The Sierra Foothills are a relatively narrow belt against their southerly topographic continuation, the abruptly rising Tehachapi Mountains. The hills are steep, and vegetation varies by elevation. At lower elevations, grasslands are characteristic, giving way to oak woodlands and mixed with conifers at higher elevations and north-facing slopes. Riparian corridors are located along the watercourses. A few settlements are found along the watercourses.

CVP Facilities in the Tulare Lake Region

These facilities primarily include water distribution systems, notably the Friant-Kern Canal. Portions of the Tulare Lake Region in the Central Valley Province are considered Variety Class C. Landscapes are uniform and generally monotonous, and they lack visual variety. The management standards are modification and maximum modification. Areas of oil development require a rehabilitation management standard.

Portions of the Tulare Lake Region in the Low Coastal Mountain Province also are considered Variety Class C. Topography provides somewhat better visual relief than the valley area. Areas of oil development require a rehabilitation management standard.

Portions of the Tulare Lake Region in the Sierra Foothills Province are considered Variety Class B. Topography, vegetation variety, and water features provide visual relief. The area also has relatively high viewer sensitivity, as it receives substantial recreational use.

WILD AND SCENIC RIVERS

Congress created the National Wild and Scenic Rivers System in 1968 (Public Law 90-542; USC 1271 *et seq.*). The purpose was to preserve rivers with outstanding natural, cultural, or recreational features in a free-flowing condition. High priority is placed on visual resource management of these rivers to preserve or restore their scenic characteristics. Rivers in the system are of three types (USFS and USDI, 1992):

- Wild rivers are free of impoundments in designated areas and generally inaccessible, except by trail. Their watersheds or shorelines are essentially primitive and their waters are unpolluted.

- Scenic rivers are free of impoundments in designated areas. Shorelines and watersheds are largely undeveloped but accessible by roads.

- Recreational rivers are readily accessible by road or railroad and may have some development along the shorelines. They may also have some impoundments and diversions.

Rivers in the national system are usually described as Wild and Scenic Rivers without regard to actual classification. However, the specific legal classification is important because it directly affects how the river is administered and whether certain activities and management standards are permissible. Federal agencies cannot assist by loan, grant, license, or otherwise in the construction of any water resources project (such as dams, water diversion, channelization, and rip-rapping) that would adversely affect river values. However, designation does not affect existing water rights or existing jurisdiction of states and the United States over waters as determined by established principles of law.

Rivers may be designated by Congress or the Secretary of the Interior. Each river is administered by either a federal agency or a state agency. The designation may or may not include the entire river, but it may include tributaries. For federally administered rivers, the designated boundaries usually average about 0.25 mile on each side of the river to protect the natural features and scenic qualities. Rivers may be nominated for inclusion in the system. Such rivers are deemed eligible, pending further study, if they are free-flowing and possess one or more outstandingly remarkable values. An outstandingly remarkable value can be the "best of the best" or simply the best representative example of a natural or cultural value within a regional or national context. Outstandingly remarkable values are generally considered to be fish, wildlife, ecologic, geologic, scenic, recreational, historic/cultural, or hydrologic. After a river, or segment of river, is determined eligible, a federal agency must determine its suitability, which is a more subjective political analysis that may lead to a recommendation for designation by Congress. Until a

suitability recommendation is made, the federal agency involved is required to protect the outstandingly remarkable values of the eligible river.

The State of California also has its own system of protected rivers. The California Wild and Scenic Rivers System consists of rivers and river segments established by legislative action because of the extraordinary scenic, recreational, fishery, or wildlife values that the rivers or segments posses in their free-flowing condition. The Wild and Scenic Rivers or designated river segments located within the PEIS study area include at least portions of: the Klamath, the Trinity, the North Fork American, the Tuolumne, the Merced, and the Lower American rivers, as well as various tributaries. Most of these are also included in the National Wild and Scenic Rivers System. As in the national system, rivers are classified as wild, scenic, or recreational, and management requirements and restrictions are similar to those of the national system. All state and local government agencies are required to exercise their powers granted under any provision of law in a manner consistent with the policy of the California Wild and Scenic Rivers Act (PRC Section 5093.61). The Secretary of Resources is responsible for coordinating activities of state agencies that may affect rivers in the system with the activities of other state, federal, and local agencies that may affect rivers. Currently two rivers are considered eligible for designation: Mill Creek and Deer Creek (AB 653, Chapter 896). These rivers, located in eastern Tehama County, are tributaries of the Sacramento River.

From the viewpoint of visual resources assessment, all rivers designated as wild, scenic, or recreational by the federal government or State of California are regarded as having high scenic quality. Landscape management, whether under federal or state stewardship, is usually directed to preservation and enhancement.

SCENIC HIGHWAYS

Scenic highways are roads designated as scenic by the State of California or local agencies. For this analysis, only state-designated scenic highways are considered. Scenic highways are recognized as having exceptional scenic qualities or affording panoramic vistas. The following criteria are used to evaluate the eligibility of routes as scenic highways:

- The corridor through which the route passes should possess significant scenic and/or historic amenities.
- The county should have jurisdiction over the lands next to the route. Where state and county authority overlap, every attempt should be made for coordination and cooperation among the agencies.
- If possible, significant landscape and topographical areas should be present along the route.
- Routes of historic significance, or routes that connect places of interest, should be considered even though the route itself may be of marginal scenic value.

- A route or corridor that would immediately affect other county programs that manage scenic and historic preservation, should be included.

- Routes predominantly used for recreation or vacation travel should be included.

For an eligible state route to become officially designated as a state scenic highway, the county Board of Supervisors must request that Caltrans perform a corridor study of the route. A corridor study identifies the views, vegetation, and significant features along the route that should be preserved. After completion of the study, the county must prepare and adopt a program for the protection of the scenic corridor. The minimum requirements of such a plan are (1) guidelines for land use that may affect density and intensity of development, (2) detailed land and site plans, (3) control of outdoor advertising, (4) careful attention to and control of earthmoving and landscaping, and (5) the designs and appearances of structures and equipment. Plans may include restrictions on or requirements for placement of visually dominant features such as power lines and gas lines. The county then submits a request to the District Director of Transportation for designation of the route as an official scenic highway.

The officially designated state scenic highways (Caltrans, 1992), including state routes and interstates within the study area, include:

- SR 151 immediately downstream of Lake Shasta

- SR 160 in Sacramento County between the southern county line and I-5

- I-5 between I-205 (San Joaquin County) and just south of SR 152 in Merced County (includes views of the Delta-Mendota Canal)

- SR 152 from I-5 to the Madera County line (passes San Luis Reservoir)

Numerous roads eligible for designation are distributed throughout the state. Because both county-initiated and Caltrans actions are required to advance the routes to official designation, most of these routes have remained on the eligible list for some time. Eligible state highways within the study area (Caltrans, 1992) include:

- SR 44 in Shasta County
- SR 3 in Trinity County
- SR 70 in Butte County
- SR 16 in Yolo County
- SR 40 from Sierra County to Madera County
- SR 152 in Santa Clara County
- SR 33 in Fresno County
- SR 41 in Kings County
- SR 190 in Tulare County
- SR 198 in Tulare County
- SR 168 in Fresno County

CHAPTER III
ENVIRONMENTAL CONSEQUENCES

Chapter III

ENVIRONMENTAL CONSEQUENCES

INTRODUCTION

This chapter describes visual resources under the No-Action Alternative and compares the impacts of Alternatives 1 through 4 to the No-Action Alternative.

IMPACT ASSESSMENT METHODOLOGY

Impacts to visual resources are dependent upon (1) changes in cropping patterns, which may result in increased fallowed lands and associated modified agricultural viewshed, and (2) releases from storage reservoirs, which may result in a "bathtub ring" caused by the appearance of unvegetated soil at the shoreline between the water surface and the high water line.

Impacts to visual resources are evaluated using the Visual Management System (VMS) developed by the U.S. Forest Service (USFS) to evaluate visual and aesthetic resources. The primary goals of VMS are to inventory visual resources and to subsequently provide a means of identifying visual resource management standards for incorporation into forest management plans (USFS, 1973a). These management standards are presented in Table III-1. The USFS has established criteria for application of VMS to most landscape features occurring in the State of California (USFS, 1976).

VMS evaluates the relationship between landforms, vegetation, water, air, and manmade structures. The quality of a landscape scene is evaluated using the following criteria: landscape character (based on the public perception of the view), visual sensitivity (based on the proximity of the viewer to the viewshed), and deviations from the characteristic landscape (based on the presence and design of manmade alterations to the landscape). Man-made alterations that borrow from the character of the landscape are considered more harmonious than those that do not borrow their form, line, color, and texture from the surrounding area (USFS, 1973b).

Landscape character is rated (USFS, 1973a) as follows:

- Variety Class A are distinctive landscapes with high visual quality. They contain outstanding feature attractions and distinctive variety in form, line, color, texture, landform, vegetation, and water features. As a rule, Class A landscapes are favored by photographers.

- Variety Class B are quality landscapes with some variety in form, line, color, or texture, those features are generally common to the character type. Major visually -dominant features are absent. In general, such landscapes are considered pleasant to view, but are not notably the subject of photographers.

- Variety Class C are low-quality visual landscapes. They are sometimes described as monotonous because they lack variety of form, line, color, or texture.

TABLE III-1

VMS MANAGEMENT STANDARDS

Standard	Description
Preservation	Landscapes managed to preserve visual resources. Uses that alter the characteristic landscape are prohibited. Typically applied to designated wilderness and primitive areas and to Wild and Scenic Rivers.
Retention	Landscape managed so that management activities attract little attention to themselves. Activities and uses should not be evident to viewers.
Partial Retention	Management activities may be evident but should remain subordinate to the natural character of the landscape.
Modification	Landscape modification is allowed, but activities and uses are designed to complement the characteristic landscape as much as possible.
Maximum Modification	Foreground and middleground views of the altered landscape may be dominated by the management activity. However, when viewed as background, the visual characteristics of the management activity must be those of the natural surroundings.
Rehabilitation	This management approach reverses or minimizes the detrimental visual effects caused by landscape deterioration or destruction.
Unacceptable Modification	This standard is not a proactive management technique. It relies on two conditions that are not considered acceptable management activities: deterioration and destruction. Deterioration involves incremental alterations of the landscape that reduce visual quality. Destruction applies to rapid, dramatic alterations of the landscape that eliminate the characteristic landscape and change its components so that a new characteristic landscape is created.

VMS analyzes visual sensitivity with respect to the rated landscape character. Visual sensitivity includes view opportunity, viewing distance, and the sensitivity of viewers to change in the visual landscape.

Visual sensitivity varies depending on the viewer's interests; for example, a sightseer would likely be more sensitive to visual change than a person interested in commercial changes to the land.

NO-ACTION ALTERNATIVE

In the No-Action Alternative, it is assumed that retired or fallowed lands would either be reseeded with grasses and used for grazing by livestock or would revert to dryland farming, as discussed in the Vegetation and Wildlife Technical Appendix. These cultural practices are analogous historical

practices used on similar lands where fallowing occurs due to crop rotation or periodic changes in cropping pattern.

Because the cultivated and fallowed acreage patterns would be similar to historical patterns, it is anticipated that agricultural viewsheds under the No-Action Alternative would be similar to conditions described in Chapter II, Affected Environment.

Similarly, because releases from storage reservoirs would be similar to historical patterns, it is anticipated that the occurrence of the "bathtub ring" around the perimeter of reservoirs under the No-Action Alternative would be similar to historical conditions.

ALTERNATIVE 1

Under Alternative 1, irrigated acreage would be reduced by less than 1 percent in the Central Valley. Because of the integrated use of surface water and groundwater, the fallowed land may not be located contiguously. Therefore, it is anticipated that the general cultivated and fallowed acreage patterns would be similar to historical patterns, and that agricultural viewsheds under Alternative 1 would be similar to the No-Action Alternative.

The operation of certain CVP reservoirs to increase end-of-month storage in September would reduce the occurrence of the "bathtub ring" effect at those lakes, particularly during the summer months when they experience substantial use.

ALTERNATIVE 2

Under Alternative 2, irrigated acreage would be reduced by about 1.3 percent in the Central Valley. Because of the integrated use of surface water and groundwater, the fallowed land may not be located contiguously. Therefore, it is anticipated that the general cultivated and fallowed acreage patterns would be similar to historical patterns, and that agricultural viewsheds under Alternative 2 would be similar to the No-Action Alternative.

The operation of certain CVP reservoirs to increase end-of-month storage in September would reduce the occurrence of the "bathtub ring" effect at those lakes, particularly during the summer months when they experience substantial use.

ALTERNATIVE 3

Under Alternative 3, irrigated acreage would be reduced by about 4 percent in the Central Valley. Because of the integrated use of surface water and groundwater, the fallowed land may not be located contiguously. It is assumed that about 15 percent of the fallowed land would be managed as conservation lands, which would add to the visual resources. However, this would be less than 0.5 percent of the irrigated land under the No-Action Alternative. Therefore, it is anticipated that the general cultivated and fallowed acreage patterns would be similar to historical patterns, and that agricultural viewsheds under Alternative 3 would be similar to the No-Action Alternative.

The operation of certain CVP reservoirs to increase end-of-month storage in September would reduce the occurrence of the "bathtub ring" effect at those lakes, particularly during the summer months when they experience substantial use.

ALTERNATIVE 4

Under Alternative 4, irrigated acreage would be reduced by about 5 percent in the Central Valley. Because of the integrated use of surface water and groundwater, the fallowed land may not be located contiguously. It is assumed that about 15 percent of the fallowed land would be managed as conservation lands, which would add to the visual resources. However, this would be less than 0.7 percent of the irrigated land under the No-Action Alternative. Therefore, it is anticipated that the general cultivated and fallowed acreage patterns would be similar to historical patterns, and that agricultural viewsheds under Alternative 4 would be similar to the No-Action Alternative.

The operation of certain CVP reservoirs to increase end-of-month storage in September would reduce the occurrence of the "bathtub ring" effect at those lakes, particularly during the summer months when they experience substantial use.

CHAPTER IV

BIBLIOGRAPHY

Chapter IV

BIBLIOGRAPHY

California Department of Transportation, 1992, California State and County Scenic Highways.

California Office of Planning and Research, 1979, The California Water Atlas.

Caltrans, see California Department of Transportation.

U.S. Bureau of Land Management, 1980, Visual Resource Management Program: Washington, DC, GPO.

EarthInfo, Inc. 1993. EarthInfo CD^2 Reference Manual.

OPR, See California Office of Planning and Research.

Ungvari, Val. U.S. Bureau of Reclamation, raw reservoir elevation data.

U.S. Forest Service, 1973a, National Forest Landscape Management, Vol 1. and 2, Agriculture Handbook Number 434: Washington, DC, GPO.

_____, 1973b, Visual Resource Management Guides. Visual Quality Standard Determination and Application, California Region: Washington, DC, GPO.

_____, 1976, National Forest Landscape Management, Volume 2, Chapter 1, The Visual Management System, California Region Lands cape Character Types and Variety Class Criteria: Washington, DC, GPO.

U.S. Forest Service and U.S. Department of the Interior, 1992, National Wild and Scenic River Systems.

CENTRAL VALLEY PROJECT IMPROVEMENT ACT
PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

DRAFT TECHNICAL APPENDIX

Air Quality

September 1997

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LIST OF ABBREVIATIONS AND ACRONYMS

AB	Assembly Bill
ABAG	Association of Bay Area Governments
APCD	Air Pollution Control District
AQAP	Air Quality Attainment Plan
AQMD	Air Quality Management District
ARB	Air Resources Board (California)
AAQS	ambient air quality standards
BAAQMD	Bay Area Air Quality Management District
CAAQS	California Ambient Air Quality Standard
CCAA	California Clean Air Act
CO	Carbon Monoxide
CVP	Central Valley Project
FCAA	Federal Clean Air Act
M&I	municipal and industrial
MCAB	Mountain Counties Air Basin
MTC	Metropolitan Transportation Commission
NAAQS	National Ambient Air Quality Standard
NCCAB	North Central Coast Air Basin
NESHAP	National Emission Standards for Hazardous Air Pollutants
NSVAB	Northern Sacramento Valley Air Basin
NO_x	oxides of nitrogen
NO_2	nitrogen dioxide
O_3	ozone
Pb	lead
PCAPCD	Placer County Air Pollution Control District
PEIS	Programmatic Environmental Impact Statement
PM	particulate matter
PM_{10}	PM of 10 microns in aerometric diameter or less
ROG	Reactive Organic Gases
SVAB	Sacramento Valley Air Basin
SMAQMD	Sacramento Metropolitan Air Quality Management District
SFBAAB	San Francisco Bay Area Air Basin
SJVAB	San Joaquin Valley Air Basin
SJVUAPCD	San Joaquin Valley Unified Air Pollution Control District
SO_x	oxides of sulfur
SO_2	sulfur dioxide
SVAB	Sacramento Valley Air Basin
TAC	toxic air contaminants
TSP	total suspended particulates
USEPA	U.S. Environmental Protection Agency
VMT	vehicle miles of travel
YSAPCD	Yolo-Solano Air Pollution Control District

CHAPTER I

INTRODUCTION

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Chapter I

INTRODUCTION

The Draft Programmatic Environmental Impact Statement (PEIS) summarizes the evaluation of the direct and indirect impacts of implementing a wide range of actions identified in the Central Valley Project Improvement Act (CVPIA). Details of the information used in the definition of the affected environment and analysis of the environmental consequences are presented in the technical appendices of the Draft PEIS.

This technical appendix presents a summary of air quality background information that was used during the PEIS preparation, and the results of the impact analyses for conditions that occurred throughout the study area, shown in Figure I-1.

The air quality analysis was primarily based upon changes in land use because no new emission sources or traffic generation activities would occur due to the alternatives considered in the PEIS. The only changes in land uses between the alternatives were related to agricultural land uses. Information from the Agricultural Economics and Land Use Technical Appendix was used in the air quality analysis.

The assumptions and results of the analyses for Alternatives 1, 2, 3, and 4 are presented in this technical appendix and summarized in the Draft PEIS. The assumptions and results of Supplemental Analyses 1a through 1i, 2a through 2d, 3a, and 4a are summarized only in the Draft PEIS. The assumptions related to the air quality analyses for Alternatives 1, 2, 3, and 4 are presented in Table I-1. The results of the analyses are presented in Table I-2.

FIGURE I-1
STUDY AREA

TABLE I-1

SUMMARY OF ASSUMPTIONS FOR AIR QUALITY ANALYSES

Alternative or Supplemental Analysis	Assumption
No-Action Alternative	Emission rates similar to existing conditions with municipal and agricultural land uses as described in California Department of Water Resources Bulletin 160-93. No major changes in air quality regulatory actions as compared to existing conditions.
1	Changes in cultivated acreage is the primary factor that would affect air quality.
2	Same as Alternative 1.
3	Same as Alternative 1.
4	Same as Alternative 1.

TABLE I-2

SUMMARY OF IMPACT ASSESSMENT OF AIR QUALITY

Affected Factors	No-Action Alternative	Alternative 1	Alternative 2	Alternative 3	Alternative 4
		Change from No-Action Alternative			
Regional Air Quality	Similar to existing conditions	Similar to No-Action Alternative	Similar to No-Action Alternative	Similar to No-Action Alternative	Similar to No-Action Alternative

CHAPTER II
AFFECTED ENVIRONMENT

Chapter II

AFFECTED ENVIRONMENT

INTRODUCTION

This technical appendix presents an overview of air quality conditions in the PEIS study area, and provides a basis for evaluating the impacts of the CVPIA. It includes a summary of air quality conditions in air basins coincident with the PEIS study areas, and discusses potential impacts to air quality conditions that could result due to the implementation of CVPIA actions.

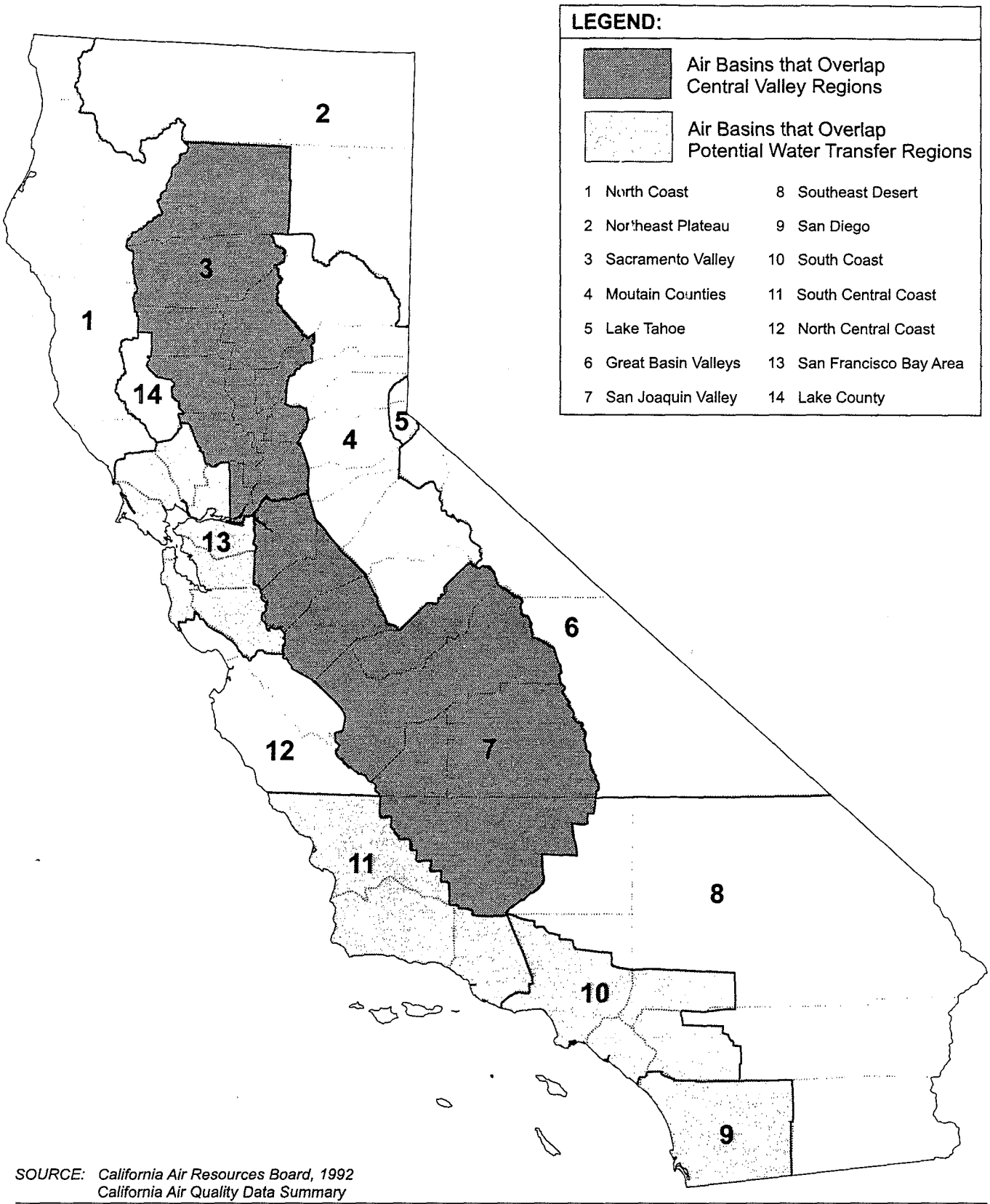
DATA SOURCES

The California Air Resources Board (ARB)-designated air basins are distinct regions within the state of California that consist of similar meteorological and topographical conditions (California ARB, 1975). These air basins generally correspond to the three PEIS regions in the Central Valley, with some overlap in the San Francisco Bay Area and along the western portion of the Sierra Nevada Mountains. The locations of these air basins are shown on Figure II-1. The relationship of the ARB-designated air basins to the PEIS regions is provided below:

Sacramento River Region	Sacramento Valley Air Basin (SVAB) San Francisco Bay Area Air Basin (SFBAAB) Mountain Counties Air Basin (MCAB)
San Joaquin River Region	San Joaquin Valley Air Basin (SJVAB) Mountain Counties Air Basin (MCAB)
Tulare Lake Region	San Joaquin Valley Air Basin (SJVAB)

The ARB publishes annual and quarterly reports entitled "California Air Quality Data," also known as the "Blue Sky" reports. For each reporting period, these reports include summaries of the number of days a pollutant exceeded a national or state standard, the average concentrations of measured pollutants, and the monitoring locations for criteria air pollutants. These reports provide an indication of which pollutants have been present in a geographic region. Reports from 1978 through 1994 were reviewed for the preparation of this technical appendix.

The ARB also publishes biannual emissions inventories, which contain estimates, in tons per day, of the criteria air pollutant contribution by various types of sources (ARB, 1978-1994). These criteria air pollutants are reported in particulate matter of 10 microns in aerometric diameter or less (PM_{10}) and in total suspended particulates (TSP). Other sources of data for the development of this technical appendix include research articles, air quality handbooks, telephone conversations, and ARB studies.



SOURCE: California Air Resources Board, 1992
California Air Quality Data Summary

FIGURE II-1

CALIFORNIA AIR BASINS

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Individual air basins or counties prepare regional plans that provide air quality goals and status information with respect to national and state ambient air quality standards for that region. The air quality analysis presented in this document used applicable regional air quality plans in the air basins that generally correspond to the PEIS geographic regions.

DATA TYPES

The data provided by the above sources generally includes 1) the number of days per year that measured pollutant concentrations exceed a state or national ambient air quality standard (AAQS), 2) annual maximum and average pollutant concentrations, and 3) the major sources in each air basin. AAQSs are based on documented health effects, rates of illness, irritation to the senses, aesthetic values, visibility, and effects on the economy. Exceedences of AAQSs trigger the requirements for an attainment plan and implementation of source reduction measures.

One type of data is an "annual average," which is the average of each air quality sample taken at each monitoring station throughout the year. Annual averages are not likely to vary much from year to year. Another data type is the "highest concentration," which is the single highest hourly (depending on the sample time) concentration monitored in the air basin. Additional data types include "exceptional events" and "extreme concentration events."

Another type of data is the number of occurrences of pollutant values that exceed a specified level. For example, the data set would include the number of samples greater than 50 parts per million (ppm), 100 ppm, and 150 ppm. The levels refer to national and state AAQSs for particulate matter. A sample corresponds to a day because concentrations are measured every 24 hours. This data type is used exclusively to measure TSP and PM_{10} concentrations.

The California Health and Safety Code requires the ARB to estimate the source and contribution of each pollutant, known as an "emissions inventory." Emissions inventory data, presented in tons/day, show the sources that have contributed the most air pollution, which may have led to AAQS exceedences.

DATA LIMITATIONS

Air quality data have been collected in California since 1978. During that time, the ARB has made modifications to the monitoring locations, monitored pollutants, and frequency of measurements. As a result, the use of historical data is subject to limitations related primarily to changes in the type, location, or frequency of data collection. The use of air quality data for the SVAB and SJVAB is subject to the following qualifications:

- The California ARB did not monitor all air quality parameters for all geographical locations between 1978 and 1992. For example, PM_{10} has only been monitored since 1985. Prior to 1985, the California ARB monitored TSP. Also several monitoring stations were added or removed from service over this period.

- The methodologies for measuring nitrogen dioxide (NO_2), lead (Pb), and PM_{10} have changed during the monitoring period.

- Prior to 1987, the California ARB monitored oxidant concentrations instead of ozone (O_3). The two are considered interchangeable.

- Sacramento Valley Air Board data for carbon monoxide (CO), nitrous oxides (NO_X), total suspended particulates (TSP), and sulfur dioxide (SO_2) show extremely high concentrations in 1978. These measurements were recorded at the Bethel Island monitoring station in eastern Contra Costa County, which is adjacent to several industrial sources, including a Pacific Gas and Electric power plant. The California ARB ceased operation of the Bethel Island monitoring station in the mid-1980s.

- Air quality monitoring generally occurs every 6 days, with constituent data for O_3, CO, SO_2, and NO_2, averaged hourly over a 24-hour period for PM_{10} and TSP.

  There are 60 monitoring days on an annual basis, and a measurement of 50 days over the PM_{10} and TSP standard means that 50 of the 60 monitoring days have a PM_{10} and TSP concentration exceeding the criteria standard. Extrapolating these measurements over a year corresponds to an 80 percent exceedance of the air quality reporting criteria, assuming that the measurements are made on 60 representative days distributed throughout the year. It is recognized that peak concentrations and number of days over a standard are influenced by the sampling times. This is particularly applicable to data collected from a single monitoring station. Basin-wide averages are generally less influenced by data collection periods.

- The locations of monitoring stations are selected to measure community-wide air quality conditions, and are operated over a period of several years. This summary also includes data from monitoring stations that operate over periods of several months.

HISTORICAL PERSPECTIVE

Declining air quality from agricultural, municipal, and industrial development and increasing population levels of cities throughout the United States prompted regulatory agencies in the 1960s to evaluate air quality and the need for controlling emissions from these activities.

The federal Clean Air Act was enacted in 1970. Pursuant to the federal Clean Air Act and its subsequent amendments, the U.S. Environmental Protection Agency (USEPA) established National Ambient Air Quality Standards (NAAQSs) for O_3, carbon monoxide (CO), PM_{10}, nitrogen oxides (NO_X), lead (Pb), and sulfur dioxide (SO_2). In addition, the California Clean Air Act, which became effective on January 1, 1989, provides a planning framework for attainment of California AAQSs.

Numerous air quality monitoring stations are located throughout the state. Data collected at those stations are used to classify areas and air basins as "attainment" or "non-attainment" for each criteria air pollutant based on whether compliance with the NAAQSs has been achieved. Air quality monitoring has occurred primarily during the past 20 years, and therefore, limited data are available to provide an historical perspective of air quality conditions. A discussion of air quality conditions, based on data collected from 1978 to the present, is included in the "Recent Conditions" Section.

RECENT CONDITIONS

Most of the air pollutants in the study area are associated with both urban and agricultural land uses, and cannot be explicitly related to one type of land use. However, some pollutants are associated with specific types of land uses. In general, four basic land uses occur within the Central Valley: irrigated agriculture, dryland (dry cropped, fallow, idle, or grazed) agriculture, municipal and industrial, and undeveloped (natural). The primary pollutants associated with all four land uses include particulate matter and hydrocarbons or organic gases that may serve as ozone precursors.

Pollutants commonly associated with agricultural land uses include PM_{10}, CO, NO_X, and O_3 precursors. PM_{10} results from field burning, and farm operations such as tilling, plowing, and the operation of farm equipment on loose earth, and entrained road dust releases and fuels combustion in vehicles and farm equipment. Particulate emissions may also occur when fallow fields do not have a cover crop to inhibit wind erosion. Carbon monoxide (CO) is released to the atmosphere during field burning and fuel combustion in farm equipment. Nitrogen oxides are also released during field burning. O_3 precursors are released in farm equipment emissions and during the application of pesticides and fertilizers. The effect of these practices on air quality conditions may be influenced by meteorological conditions, the variability of emissions controls, and the adoption and enforcement of emissions regulations.

Many municipal and industrial practices result in hydrocarbon and particulate emissions. Sources of hydrocarbon emissions include fuel combustion in vehicles and industrial equipment, painting and solvent use, and residential heating. Sources of particulate emissions include dust entrained in pavement, structural and automobile fires, construction and demolition, residential fuel combustion, and fuel consumption in vehicles. Air pollutants typically associated with urban and industrial uses are not discussed in this technical appendix because it is anticipated that urban land use conditions would not be affected by CVPIA actions. A discussion of M&I land uses, and potential impacts are discussed in the Municipal and Industrial Land Use Technical Appendix. Therefore, this technical appendix focuses on potential impacts to air quality conditions that would result from changes in agricultural land uses.

In undeveloped areas, hydrocarbon emissions primarily result from wildfires, and particulate emissions result from windblown dust and wildfires.

No clear relationship exists between agricultural acres and the occurrence of O_3 and PM_{10} in the atmosphere. Several variables other than land uses can affect air quality conditions, and these variables may change over time. Examples of variables that have influenced air quality conditions in the Central Valley between 1978 and 1992 are summarized below.

- Legislation. Congress substantially amended the federal Clean Air Act (FCAA) in 1977 and again in 1990. Under both amendments, the FCAA required the USEPA to set more stringent national ambient air quality standards. The standards are intended to be met through stringent emission standards for new vehicles and stationary sources. Tight emission standards for mobile sources could have decreased the number of days that the O_3 national and state standard was violated.

- Adoption of air quality attainment plans (AQAPs). As required by the California Clean Air Act (CCAA), air basins that are designated non-attainment for criteria pollutants must prepare Air Quality Attainment Plans (AQAPs). Control measures presented in the AQAPs are intended to reduce O_3 precursor and PM_{10} emissions, and also decrease the number of national or state AAQS violations. As AQAPs have been developed and implemented, air quality conditions have changed during the past 20 years.

- Change in urban land uses. Land use planning in the Central Valley in the 1970s emphasized automobile travel over other modes of transportation. Suburban shopping malls, subdivisions with limited access, and larger homes were constructed in the Central Valley. This land use trend emphasized dependence on the automobile (San Joaquin Valley Unified Air Pollution Control District [SJVUAPCD], 1993). Coupled with a population increase, this type of land use has resulted in an increase of vehicle miles of travel (VMT). An increase in VMT and longer commuting distances could result in a corresponding increase in the number of days that the O_3 standard would be exceeded. An increase in VMT also generally increases entrained road dust (SJVUAPCD, 1992).

- Agricultural burning programs. Both the SVAB and SJVAB oversee agricultural burning programs implemented as control measures in AQAPs (SJVUAPCD, 1992; Sacramento Metropolitan Air Quality Management District [SMAQMD], 1991). PM_{10} emissions should have decreased as these programs were implemented.

- Population. The most significant variable that influences air quality in the SJVAB is population growth. An increase in population usually increases air pollution sources (SJVUAPCD, 1992). Population changes would also affect air pollution in the SVAB. Data are not adjusted for population growth.

- Meteorological conditions. O_3 is formed through photochemical reactions involving sunlight and hydrocarbon emissions. PM_{10} concentrations are higher when strong winds coincide with harvesting and agricultural burning. The variability of meteorological conditions during the 1978 to 1994 period influenced the number of O_3 and PM_{10} exceedances. Air quality data are not adjusted for changes in meteorological conditions.

REGULATORY REQUIREMENTS

Air quality is regulated through both federal and State of California AAQSs. A summary of the national and State AAQSs is presented in Table II-1. The following sections describe applicable federal and State air quality regulations.

Federal Air Quality Criteria

The federal Clean Air Act requires the USEPA to identify NAAQSs to protect public health and welfare. The USEPA established NAAQSs for ozone (O_3), carbon monoxide (CO), oxides of nitrogen as nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter of respirable size (PM_{10}), and lead (Pb). Primary standards for air pollutants were established to protect public health, and secondary standards were established to protect the public welfare by preventing impairment of visibility and damage to vegetation and property. These six air pollutants are

TABLE II-1

STATE AND NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Time	California Standards (1)		National Standards (2)		
		Concentration (3)	Method (4)	Primary (3,5)	Secondary (3,4,6)	Method (4,7)
Ozone	1-Hour	0.09 ppm (180 μg/m [3])	Ultraviolet Photometry	0.12 ppm (235 μg/m [3])	Same as Primary Standard	Ethlyene Chemi-luminescence
Carbon Monoxide	8-Hour	9.0 ppm (10 mg/m [3])	Non-dispersive Infrared Spectroscopy (NDIR)	9.0 ppm (10 mg/m [3])		Non-dispersive Infrared Spectroscopy (NDIR)
	1-Hour	20 ppm (23 mg/m [3])		35 ppm (40 mg/m [3])		
Nitrogen Dioxide	Annual Average	-	Gas Phase Chemiluminescence	0.053 ppm (100 μg/m [3])		Gas Phase Chemiluminescence
	1-Hour	0.25 ppm (470 μg/m [3])		-		
Sulfur Dioxide	Annual Average	-	Ultraviolet Fluorescence	80 μg/m (3) (0.03 ppm)	-	Pararosoaniline
	24-Hour	0.05 ppm (131 μg/m [3])		365 μg/m (3) (0.14 ppm)	-	
	3-Hour	-		-	1,300 μg/m (3) (0.5 ppm)	
	1-Hour	0.25 ppm (655 μg/m [3])		-	-	
Suspended Particulate Matter (PM_{10})	Annual Geometric Mean	30 μg/m (3)	Size Selective Inlet High Volume Sampler and Gravimetric Analysis	-	-	Inertial Separation and Gravimetric Analysis
	24-Hour	50 μg/m (3)		150 μg/m (3)	Same as Primary Standard	
	Annual Arithmetic Mean	-		50 μg/m (3)	Same as Primary Standard	
Sulfates	24-Hour	25 μg/m (3)	Turbidimetric Barium Sulfate	-	-	-
Lead	30-Day Average	1.5 μg/m (3)	Atomic Absorption	-	-	Atomic Absorption
	Calendar Quarter	-		1.5 μg/m (3)	Same as Primary Standard	
Hydrogen Sulfide	1-Hour	0.03 ppm (42 μg/m [3])	Cadmium Hydr-oxide Stractan	-	-	-
Vinyl Chloride (Chloroethene)	24-Hour	0.010 ppm (26 μg/m [3])	Tedlar Bag Collection, Gas Chromatography	-	-	-

TABLE II-1 CONTINUED

Pollutant	Averaging Time	California Standards (1)		Primary (3,5)	National Standards (2)	
		Concentration (3)	Method (4)		Secondary (3,4,6)	Method (4,7)
Applicable Only in the Lake Tahoe Air Basin						
Visibility Reducing Particles (8)	8-Hour (10 am to 6 pm, PST)	In sufficient amount to produce an extinction coefficient of 0.23 per kilometer due to particles when the relative humidity is less than 70 percent. Measurement in accordance with ARB Method V.		-	-	-
Carbon Monoxide	8-Hour	6 ppm (7 mg/m [3])	NDIR	-	-	-
Visibility Reducing Particles (9)	8-Hour (10 am to 6 pm, PST)	In sufficient amount to produce an extinction coefficient of 0.23 per kilometer due to particles when the relative humidity is less than 70 percent. Measurement in accordance with ARB Method V.		-	-	-

NOTES:

(1) California standards for ozone, carbon monoxide (except Lake Tahoe), sulfur dioxide (1-hour and 24-hour), nitrogen dioxide, suspended particulate matter - PM_{10}, and visibility reducing particles, are values that are not to be exceeded. The standards for sulfates, Lake Tahoe carbon monoxide, lead, hydrogen sulfide, and vinyl chloride are not to be equaled or exceeded.

(2) National standards, other than ozone and those based on annual averages or annual arithmetic means, are not to be exceeded more than once a year. The ozone standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above the standard is equal to or less than one.

(3) Concentration expressed first in units in which it was promulgated. Equivalent units given in parenthesis are based upon a reference temperature of 25° C and a reference pressure of 760 mm of mercury. All measurements of air quality are to be corrected to a reference temperature of 25° C and a reference pressure of 760 mm of mercury (1,013.2 millibar); ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas.

(4) Any equivalent procedure which can be shown to the satisfaction of the Air Resources Board to give equivalent results at or near the level of the air quality standard may be used.

(5) National Primary Standards: The levels of air quality necessary, with an adequate margin of safety to protect the public health. Each state must attain the primary standards no later than three years after that state's implementation plan is approved by the U.S. Environmental Protection Agency (USEPA).

(6) National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant. Each state must attain the secondary standards within a "reasonable time" after the implementation plan is approved by the USEPA.

termed "criteria" pollutants because the standards established for them were based on documented human health criteria.

Pursuant to the 1990 Federal Clean Air Act Amendments, USEPA has classified air basins (or portions thereof) as either "attainment" or "nonattainment" for each criteria air pollutant, based on whether the NAAQSs have been achieved. A summary of the current attainment status of counties within the PEIS study area, with respect to federal air quality standards is provided in Table II-2. O_3 nonattainment areas are categorized as "extreme," "severe," "serious," "moderate," or "marginal." The CO and PM_{10} nonattainment regions are classified as "serious" or "moderate." The nonattainment classifications are also shown in Table II-2. These qualitative classifications describe the relative magnitude and severity of the problem in nonattainment areas.

State of California Air Quality Criteria

The California ARB classifies air pollution sources into two categories: mobile and stationary. Mobile sources include vehicles and aircraft, whereas stationary sources include fuel combustion, waste burning, solvent use, petroleum process, and industrial processes. Agricultural sources (not a California ARB category) fall into several stationary and mobile source categories. For example, agricultural CO is emitted by tractors (a mobile source) and field burning (a stationary source). References to "agricultural emissions" in this section could therefore involve both mobile and stationary sources.

The California ARB regulates mobile emission sources and oversees the activities of county air pollution control districts (APCDs) and regional air quality management districts (AQMDs). The California ARB regulates local air quality indirectly by establishing state ambient air quality standards and vehicle emission standards, conducting research activities, and planning and coordinating activities. The APCDs and AQMDs regulate existing and new air pollution sources through their permitting processes. They are also responsible for creating air quality attainment plans (AQAPs) that involve control measures for stationary and mobile sources. Control measures are programs or projects used to control, reduce, or eliminate future air pollutant emissions, such as implementation of ride-share programs. The goal of the APCDs and AQMDs is to attain national and state air quality standards.

California's AAQSs are more stringent than the NAAQSs for the criteria air pollutants. Under the California Clean Air Act, which is patterned after the federal Clean Air Act, areas such as air basins, or portions thereof, have been designated as attainment or nonattainment with respect to state AAQSs. A summary of the current attainment status of counties within the PEIS study area, with respect to state AAQSs, is provided in Table II-3.

CRITERIA POLLUTANTS

This section provides general descriptions of the criteria pollutants that have historically been measured in the Central Valley.

TABLE II-2

NATIONAL AIR QUALITY ATTAINMENT STATUS FOR CRITERIA POLLUTANTS IN THE PROJECT AREA

Area	O_3	CO	NO_2	SO2	PM_{10}
SACRAMENTO VALLEY REGION OF THE CVP STUDY AREA					
Shasta County	UA	UA	UA	U	U
Tehama County	UA	UA	UA	U	U
Glenn County	UA	UA	UA	U	U
Butte County	N	N/UA	UA	U	U
Colusa County	UA	UA	UA	U	U
Sutter County	N	UA	UA	U	U
Yuba County	N	UA	UA	U	U
Sacramento County	N	N/UA	UA	U	N
Yolo County	N	N/UA	UA	U	U
East Solano County	N	UA	UA	U	U
East Placer County	N	UA	UA	U	U
Middle Placer County	N	N/UA	UA	U	U
Amador County	UA	UA	UA	U	U
El Dorado County	N	UA	UA	U	U
Nevada County	UA	UA	UA	U	U
West Solano County	UA	N/UA	UA	A	U
Napa County	UA	N/UA	UA	A	U
Contra Costa County	UA	N/UA	UA	A	U
SAN JOAQUIN RIVER BASIN AND TULARE BASIN REGIONS OF THE CVP STUDY AREA					
San Joaquin County	N	N/UA	UA	U	N
Stanislaus County	N	N/UA	UA	U	N
Merced County	N	UA	UA	U	N
West Madera County	N	UA	UA	U	N
West Fresno County	N	N/UA	UA	U	N
Kings County	N	UA	UA	U	N
West Tulare County	N	UA	UA	U	N
West Kern County	N	N/UA	UA	A	N
West Mariposa County	UA	UA	UA	U	U
West Tuolumne County	UA	UA	UA	U	U
West Calaveras County	UA	UA	UA	U	U

NOTES:
- N = Nonattainment
- A = Attainment
- U = Unclassified
- UA = Unclassified/Attainment for areas that cannot be classified or are better than the national standards
- / = This symbol separates the urbanized area designation from the designation for the remainder of the county

SOURCE:
California ARB, 1996

TABLE II-3

STATE AIR QUALITY ATTAINMENT STATUS FOR CRITERIA POLLUTANTS IN THE PROJECT AREA

Area	O_3	CO	NO_2	SO2	PM_{10}
SACRAMENTO VALLEY REGION OF THE CVP STUDY AREA					
Shasta County	N	U	A	A	N
Tehama County	N	U	A	A	N
Glenn County	N	U	A	A	N
Butte County	N	N/U	A	A	N
Colusa County	N	U	A	A	N
Sutter County	N	U	A	A	N
Yuba County	N	U	A	A	N
Sacramento County	N	T/A	A	A	N
Yolo County	N	A	A	A	N
East Solano County	N	A	A	A	N
East Placer County	N	U	A	A	N
Middle Placer County	N	U	A	A	U
West Amador County	N	U	A	A	U
West El Dorado County	N	U	A	A	U
West Nevada County	N	U	A	A	U
West Solano County	N	A	A	A	N
Napa County	N	A	A	A	N
Contra Costa County	N	A	A	A	N
SAN JOAQUIN RIVER BASIN AND TULARE BASIN REGIONS OF THE CVP STUDY AREA					
San Joaquin County	N	A	A	A	N
Stanislaus County	N	A	A	A	N
Merced County	N	U	A	A	N
West Madera County	N	U	A	A	N
West Fresno County	N	N/A	A	A	N
Kings County	N	U	A	A	N
West Tulare County	N	A	A	A	N
West Kern County	N	A	A	A	N
West Mariposa County	N	U	A	A	N/U
West Tuolumne County	N	U	A	A	U
West Calaveras County	N	U	A	A	U

NOTES:
N = Nonattainment
A = Attainment
U = Unclassified
/ = This symbol separates the urbanized area designation from the designation for the remainder of the county

SOURCE:
California ARB, 1996

Ozone (O_3)

O_3, a pungent, colorless, acutely toxic gas, is primarily produced by photochemical processes in the atmosphere. Reactive organic gases (ROG), including hydrocarbons and NO_X react in the atmosphere to form ozone. Emissions from motor vehicles are the major source of NO_X and ROG in the PEIS study area. The common effects of ozone and other photochemical oxidants are eye irritation, respiratory difficulties, and damage to vegetation. Photochemical oxidants in high concentrations (ranging from 0.15 ppm to 0.50 ppm) can directly cause respiratory system damage to humans and animals. Health effects are particularly acute in children and elderly people. Ozone also interferes with photosynthesis, damaging plants and agricultural crops (SMAQMD, 1991).

Carbon Monoxide (CO)

CO, a colorless, odorless, toxic gas, is produced through the incomplete combustion of fossil fuels. Concentrations of carbon monoxide are generally higher in winter when more fuel is burned and weather conditions in the Central Valley favor the buildup of directly emitted contaminants. Emissions from gasoline-powered engines are the major source of this contaminant, with automobiles as the primary contributor. Industrial processes also produce CO emissions through incomplete combustion of fossil fuels. CO does not irritate the respiratory tract; however, it passes through the lungs directly into the blood stream, where it may interfere with the transfer of oxygen and deprive sensitive tissues of oxygen (SMAQMD, 1991).

Oxides of Nitrogen (NO_X) as Nitrogen Dioxide (NO_2)

NO_X is a direct participant in photochemical reactions that produce smog. NO_X is formed by high combustion temperatures that cause atmospheric nitrogen and oxygen to form nitric oxide (a colorless, odorless gas). The emitted compound, NO, reacts with oxygen in the atmosphere in the presence of hydrocarbons and sunlight to form O_3 and NO_2 (a reddish-brown irritating gas) (SMAQMD, 1991). The national and state air pollutant is NO_X as NO_2.

Sulfur Dioxide (SO_2)

SO_2, a colorless, pungent, irritating gas, is formed primarily by the combustion of sulfur-containing fossil fuels. In humid atmospheres, SO_2 may change to sulfur trioxide and sulfuric acid mist, with the latter eventually reacting with other materials to produce sulfate particulates. Fuel combustion is the major source of SO_2, while chemical facilities, sulfur recovery facilities, and metal processing are minor contributors. At sufficiently high concentrations, SO_2 causes irritation to the upper respiratory tract (Freedman, 1989).

Particulate Matter

Total suspended particulate (TSP) refers to airborne dust that consists of particles small enough to remain suspended in the air for long periods of time. Fine particulate matter (PM_{10}) includes particulates of 10 microns or less in diameter. PM_{10} are small enough to pass through the respiratory system when inhaled, and to become lodged in the lungs, resulting in adverse health

effects (SMAQMD, 1991). PM_{10} may be composed of dust, sand, salt spray, metallic and mineral particles, pollen, smoke, mist, and acid fumes. Primary anthropogenic (man-made) sources of PM_{10} are agricultural operations, demolition and construction activities, entrainment of road dust by motor vehicles, and wood burning. Natural sources and wind erosion of agricultural land also represent significant sources of airborne dust (California ARB, 1989).

Lead (Pb)

Historically, emissions from gasoline-powered automobile engines were the major source of airborne Pb in urban areas. However, since the use of leaded fuel was discontinued in California in 1990, ambient Pb concentrations have been substantially reduced. Lead can cause hematological (blood-related) effects, such as anemia (iron-deficient blood) and inhibition of enzymes involved in blood synthesis. Pb may also affect the central nervous system and reproductive systems (Freedman, 1989).

NON-CRITERIA POLLUTANTS

In addition to the criteria pollutants, concern about non-criteria pollutants, or toxic air contaminants has been increasing in recent years. Toxic air contaminants (TACs) include airborne inorganic and organic compounds that can have both short-term (acute) and long-term (carcinogenic, chronic, and mutagenic) affects on human health.

Prior to the 1990 amendments to the Clean Air Act, the USEPA conducted a program to establish National Emission Standards for Hazardous Air Pollutants (NESHAPs). NESHAPs were established for benzene, vinyl chloride, radionuclides, mercury, asbestos, beryllium, inorganic arsenic, radon 222, and coke oven emissions. The 1990 Clean Air Act amendments require U.S. Environmental Protection Agency (USEPA) to set standards for categories and subcategories of sources that emit hazardous air pollutants, rather than for the pollutants themselves. USEPA began issuing the new standards in November 1994. NESHAPs set before 1991 remain applicable.

Assembly Bill (AB) 1807 (the Tanner Bill, passed in 1983) established the State Air Toxics Program for identifying and developing emissions control and reduction methods for TACs. Eighteen substances were formally designated TACs under AB 1807. In 1993, the 189 hazardous air pollutants (HAP) identified by USEPA were incorporated into California law as TACs (Denton, 1996). The California Air Toxics Hot Spots Information and Assessment Act of 1987 (AB 2588) regulates more than 700 air toxics, including all designated TACs. Under AB 2588, industrial and municipal facilities emitting more than 10 tons per year of any criteria air pollutant must estimate and report their TAC emissions to the local air districts. The local air districts then prioritize facilities based upon emissions. High-priority facilities are required to submit a human health risk assessment. If the predicted health risks are great enough, the facility must communicate the results to the public and implement a risk reduction program.

Some agricultural operations, such as aerial spraying of pesticides and herbicides, are considered sources of non-criteria pollutants or TACs; however, these operations are exempt from AB 2588. Agricultural operations that involve the processing of agricultural goods are subject to AB 2588.

Examples of such agricultural operations include food processing plants, hauling and transport companies, and biomass conversion (Kharazi, 1993).

EFFECTS OF CLIMATE AND METEOROLOGY ON AIR QUALITY

Overall air quality conditions in an air basin are influenced by several regional factors, including the proximity of air pollutant sources, quantities of pollutant emissions, and meteorological and topographical conditions affecting their dispersion. Atmospheric conditions, including wind speed, wind direction, and air temperature gradients, interact with the physical features of the landscape to affect the dispersion and concentration distributions of air pollutants. A discussion of the climate and meteorological conditions of the three PEIS regions in the Central Valley is provided in the following sections.

SACRAMENTO VALLEY AIR BASIN

Climate and Meteorology

The SVAB includes the northern portion of the Central Valley, including the lower slopes of surrounding mountain ranges. The climate generally consists of hot summers and cool, rainy winters. Approximately 90 percent of the rainfall occurs between November and April with little or no precipitation occurring from late spring to early fall (NOAA, 1990). Prevailing winds are usually oriented along the major axis of the Sacramento Valley following a southeast-northwest pattern.

During the summer, the Pacific high-pressure system isolates the entire Sacramento Valley Air Basin from storms and creates inversion layers in the valley. These inversion layers prevent the vertical dispersion of air. In addition, topographic barriers prevent lateral dispersion. Because of the vertical and lateral confinement, air pollutants in the Sacramento Valley Air Basin become concentrated during summer months (Sacramento Air Quality Management District [SMAQMD], 1991).

During winter, the Pacific high-pressure system moves south, and stormy, rainy weather intermittently dominates the valley. Prevailing winter winds from the southeast disperse pollutants and provide clear, sunny weather at higher levels in the atmosphere.

Recent Air Quality Conditions

The air quality of the Northern Sacramento Valley Air Basin (NSVAB) is currently designated as nonattainment with respect to national and state O_3 and PM_{10} standards. The Chico urban area is designated as nonattainment for the national and state CO standards (California ARB, 1996). In 1994, an air quality attainment plan was prepared to identify how the national and state clean air standards could be attained in this region at the earliest practicable date.

In accordance with the California Clean Air Act (CCAA), the Plan assessed changes in projected emissions through the year 2000, and determined that emissions of ROG and NO_X must be reduced by 89.2 and 75.2 tons per day, respectively. To achieve these reductions, control measures in addition to measures in place at the time would be required. The new control measures outlined in the AQAP include public information programs to inform the public of district activities, regulations, and air quality levels; an agricultural burning program to regulate burn events, and monitor and reduce O_3 and PM_{10} levels; transportation control measures to reduce O_3 and PM_{10} emissions; and ROG-related control measures to minimize emissions from manufacturing and handling of specific substances (NSVAB, 1994).

The air quality of the Southern portion of the SVAB is overseen by the Sacramento Metropolitan Air Quality Management District (SMAQMD), the Yolo-Solano Air Quality Management District (YSAQMD), and the Placer County Air Pollution Control District (PCAPCD). The counties within this basin include Sacramento, eastern Solano, and Yolo counties, and most of Placer County.

The SVAB is designated as nonattainment with respect to national and state O_3 standards. Sacramento County is nonattainment with respect to both national and state PM_{10} standards; whereas, Placer, Solano, and Yolo counties are nonattainment with respect to only the state PM_{10} standards (California ARB, 1996). In 1994, the El Dorado County Air Pollution Control District and the Feather River Air Quality Management District prepared a Sacramento Area Proposed Regional Ozone Attainment Plan to meet national and state clean air standards in the SVAB at the earliest practicable date.

In accordance with the California Clean Air Act (CCAA), the Plan assessed changes in projected emissions through the year 2000, and determined that emissions of ROG and NO_X would need to be reduced in order to reach attainment status. The districts used analytical models to predict emissions to the year 2005 and determined that the forecasted emissions need to be reduced by 36 and 37 tons per day for ROG and NO_X, respectively. To achieve these reductions, control measures, in addition to measures in place at the time, would be required.

The new control measures outlined in the Plan include a variety of programs to reduce NO_X and ROG emissions. NO_X emissions reductions were targeted at heavy duty on-road and non-road vehicles, and stationary combustion equipment. ROG emissions reductions were targeted at facilities involved in the manufacturing and handling of coatings and solvents; operations and materials associated with petroleum and chemical industries; and the operations of restaurants and bakeries, waste, soil remediation, and waste burning.

An Attainment Plan for PM_{10} in Sacramento County is currently under preparation by SMAQMD and is not expected to be published until 1997 (Tholen, 1996). Elsewhere in the region, PM_{10} attainment plans have not been prepared. In Yolo, Solano, and Placer counties, YSAQMD and PCAPCD are currently assessing whether attainment plans are necessary.

Summaries of recent air quality conditions in the SVAB for specific pollutants of concern in this region are provided below.

Carbon Monoxide. From 1978 to 1992, national and state CO 8-hour standard was violated about 5 to 12 days per year between 1978 and 1992. Neither standard was violated in 1992 or 1994, and the standards were only violated twice in 1993. For the most part, the 1-hour standard is achieved. Mobile sources contributed approximately 83 percent (1,321 tons/day) and 75 percent (999 tons/day) of total CO in 1980 and 1990, respectively. Of the stationary sources, agricultural sources (fuel combustion by farm equipment, waste burning, and range management) contributed approximately 10 percent (164 tons/day) and 14 percent (186 tons/day) of total CO emissions in 1980 and 1990, respectively. Agricultural waste burning was the largest CO source in 1990 (California ARB, 1989b).

Ozone. The maximum hourly O_3 concentration appears to be declining in the SVAB. The number of days each year in exceedence of the national and state standard varies year to year. Similar to CO, mobile sources emit the largest quantities of O_3 precursors (ROG and NO_X) in the SVAB.

Mobile sources emitted approximately 60 percent (336 tons/day) and 52 percent (123 tons/day) of total ROG in 1980 and 1990, respectively. Agricultural sources contributed approximately 11 percent (40 tons/day) and 12 percent (28 tons/day) of total ROG in 1980 and 1990, respectively. Pesticide application was the single largest agricultural source of ROG in both years. Mobile sources also emitted most NO_X, contributing approximately 90 percent (205 tons/day) and 86 percent (180 tons/day) of total NO_X in 1980 and 1990, respectively. Agricultural sources contributed negligible amounts of NO_X in both years (ARB, 1989b).

Particulate Matter and Total Suspended Particulates. California ARB monitored TSP prior to 1987 and began monitoring PM_{10} in 1985. PM_{10} concentrations remained relatively constant through the late 1980s and declined in the early 1990s. The number of days over 50 ppm (state standard) and 150 ppm (national standard) generally reflect this trend. Stationary sources contributed approximately 94 percent (293 tons/day) and 95 percent (382 tons/day) of total PM_{10} emissions in 1980 and 1990, respectively. The single largest stationary source in 1990 was entrained road dust by automobiles, contributing approximately 38 percent (155 tons/day) of total PM_{10} emissions. Agricultural sources accounted for approximately 34 percent (137 tons/day) of total PM_{10} emissions in 1990. Of all agricultural sources, farming operations (e.g., soil cultivating and plowing) emitted the most PM_{10} (California ARB, 1989b).

Sulfur Dioxide. Average SO_2 concentrations were fairly consistent between 1980 and 1987, but increased in the late 1980s. Between 1987 and 1994, exceedences have occurred, but the trend since 1988 has been generally downward. In 1990, mobile sources contributed approximately 80 percent (20 tons/day) of total SO_2 emissions in the SVAB. Other SO_2 sources included industrial and petroleum operations (California ARB, 1989b).

Lead. In the past 15 years, lead levels have decreased substantially because of lead removal from gasoline. Neither the national nor the state lead standard was violated between 1978 and 1992.

SAN JOAQUIN VALLEY AIR BASIN

Climate and Meteorology

The SJVAB includes the southern portion of Central Valley, including the lower slopes of surrounding mountain ranges. The climate generally consists of hot summers and cool, rainy winters. Summer inversions are similar to those of the SVAB. Approximately 90 percent of the rainfall occurs between November and April, with little or no precipitation occurring from late spring to early fall (NOAA, 1990).

Prevailing winds are usually oriented along the major axis of the San Joaquin Valley, approximately following a northwest-southeast pattern. A calm air flow pattern is predominant during the winter. During the spring, summer, and fall seasons, the predominant flow pattern is northwest to southwest (California ARB, 1984).

In summer, the Pacific high-pressure system moves north and no major storms or precipitation occur, creating daily inversion layers characterized by a layer of cool air over warm air. Surrounding mountains are above the height of summer inversion layers. As a result, the SJVAB is highly susceptible to pollutant accumulation over time (SJVUAPCD, 1991).

In the winter, the influence of the Pacific high-pressure system moves south and gives rise to alternate periods of unsettled stormy weather and stable rainless conditions with winds from the southwest. Most of the San Joaquin Valley is in the rainshadow of the Coast Range and depends on cold, unstable northwesterly flow for its precipitation, which produces showers following frontal passages.

Recent Air Quality Conditions

The air quality of the SJVAB is regulated by the San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD) which consists of Merced, Madera, Fresno, Kern, Kings, San Joaquin, Stanislaus, and Tulare counties. The entire SJVAB is designated nonattainment with respect to the national and state O_3 and PM_{10} standards, and the urban areas of Fresno, Modesto and Stockton are nonattainment for the national and state CO standards (California ARB, 1996).

The SJVUAPCD prepared a 1994 Ozone Attainment Demonstration Plan to meet national and state O_3 standards and the Proposed 1996 Rate of Progress Plan to monitor the O_3 attainment status. The SJVUAPCD also prepared the 1994 Serious Area PM_{10} Plan to meet the national and state PM_{10} clean air standards at the earliest practicable date. Because these reports are anticipated to meet the more rigorous state ambient air quality standards, federal requirements are also expected to be met.

The SJVAB used analytical models to predict emissions to the year 1999, and determined that the VOC and NO_X emissions predicted for 1999 would result in exceedences of the national ozone standard in areas of the SJVAB with the continuation of existing control measures. Therefore, new control measures were determined necessary to reach attainment by the year 1999.

New control measures outlined in the Plan include a variety of programs to reduce NO_X and ROG emissions. NO_X emission reductions were targeted at gas turbine engines; transportation vehicles; emissions from furnaces, oil well drilling rigs, engines, generators, small boilers, steam generators, process heaters; and stationary internal combustion. ROG emission reductions targeted all phases of natural gas production; emissions from organic liquid storage tanks, transportation vehicles, restaurants, small printing operations, landfill gas; and manufacturing and handling of adhesives, coatings, organic solvent degreasing, organic solvent waste.

According to monitoring data, exceedences of the 24-hour standard are generally seasonal and occur during the fall and winter months. The increase in precipitation during the fall of 1992, marked the end of an extended drought, and dramatically reduced PM_{10} levels in the air basin.

The control measures outlined in the Serious Area PM_{10} Plan for agricultural operations include dust control conservation practices and wind erosion control conservation practices; fowl and livestock waste conservation practices; curtailment of or alternatives to residential wood burning; forest and land management through prescribed burning; reduction of PM_{10} precursors, such as ammonium nitrate and ammonium sulfate; public information and educational programs; preparation of air quality guidelines for general plans; review of projects that may generate indirect source emissions; and reduction of ROG emissions from transportation vehicles (SJVAB, 1994b).

Summaries of recent air quality conditions in the San Joaquin Valley Air Basin for specific pollutants of concern in this region are provided below.

Carbon Monoxide. The number of days each year over the national and state CO 8-hour standard declined in the mid- to late-1980s, was higher in 1989, and then declined to no exceedences in 1992 to 1994. The 1-hour standard is violated much less frequently. Mobile sources accounted for approximately 83 percent (1,351 tons/day) and 77 percent (1,178 tons/day) of total CO in 1980 and 1990, respectively. Agricultural sources (fuel combustion by farm equipment, waste burning and range management) contributed approximately 8 percent (138 tons/day) and 10 percent (160 tons/day) of total CO emissions in 1980 and 1990, respectively. Waste burning was the single largest agricultural source (ARB, 1989b).

Ozone. The national and state O_3 standards have been exceeded on a fairly regular basis. O_3 precursors (NO_X and ROG) are almost evenly emitted by mobile and stationary sources in the SJVAB. Mobile sources contributed approximately 56 percent (315 tons/day) and 51 percent (292 tons/day) of total NO_X in 1980 and 1990, respectively. Stationary sources contributed approximately 74 percent (695 tons/day) and 74 percent (435 tons/day) of total ROG in 1980 and 1990, respectively. Of all ROG stationary sources, agricultural operations contributed approximately 12 percent (115 tons/day) and 14 percent (85 tons/day) in 1980 and 1990, respectively. Pesticide application was the single largest agricultural source of ROG in both years (California ARB, 1989b).

Nitrogen Dioxide. Average NO_2 concentrations have been consistently below the average annual national and 1-hour state standard. Petroleum processing was the largest stationary source of NO_X in both years. The agricultural contribution of NO_X was negligible.

Particulate Matter and Total Suspended Particulates. Total suspended particulates concentrations generally declined between 1978 and 1987, with an exception in 1985. PM_{10} concentrations show considerable variation between 1985 and 1994. Stationary sources contributed approximately 93 percent (459 tons/day) and 94 percent (580 tons/day) of total PM_{10} emissions in 1980 and 1990, respectively. Of the total stationary source contribution, agricultural sources contributed approximately 37 percent (229 tons/day) of total PM_{10} emissions in 1990. The single largest agricultural of particulate matter source was farming operations (ARB, 1989b).

Sulfur Dioxide. Maximum SO_2 concentrations decreased considerably between 1978 and 1994. The state standard was exceeded frequently in the early 1970s, but this decreased to only a few times in the late 1970s, following the concentration trend. Stationary sources contributed approximately 82 percent (120 tons/day) and 67 percent (73 tons/day) of total SO_X emissions. Oil and gas production was the largest stationary source of SO_X in both years.

Lead. The national and state lead standards were exceeded in the SJVAB in the late 1970s and 1980.

MOUNTAIN COUNTIES AIR BASIN

Climate and Meteorology

The MCAB is directly affected by the upward currents (east-northeasterly and southerly) from the Sacramento Valley and Bay Area air basins (ARB, 1984). The ARB identified these air basins as "significant" transporters of air pollutants into the mountain counties. The transport contribution from these regions is significant, as upwind air basins have independently caused exceedences of the state O_3 standard in the MCAB (SJVAB, 1994a).

Recent Air Quality Conditions

Within the Sacramento River Region of the PEIS Study Area, the air quality of the MCAB is overseen by separate air pollution control districts in Placer, Amador, El Dorado, and Nevada counties. Amador and Nevada counties are in attainment with federal ozone standards and are nonattainment with state ozone standards. Placer and El Dorado counties are nonattainment for the national and state ozone standards. The mountain counties are considered nonattainment as a direct result of overwhelming transport of O_3 from the San Joaquin Valley into this region via air currents. Therefore, the SJVUAPCD should be responsible for preparing and addressing attainment of O_3 standards for the air entering these counties (Bonderson, 1996). Because the counties are considered unclassified for PM_{10}, no attainment plans for PM_{10} were necessary or have been produced for these counties.

The air quality in the portion of the MCAB located within the San Joaquin River and Tulare Lake Regions of the PEIS Study Area is regulated by separate air pollution control districts in Mariposa, Calaveras, and Tuolumne counties. These individual counties are nonattainment for the state O_3 standard but only Mariposa County is nonattainment for the state PM_{10} standard. Mariposa County is considered nonattainment as a direct result of overwhelming transport of PM_{10} and O_3 from the San Joaquin Valley into this region via air currents (Rodeman, 1996). Calaveras and Tuolumne counties are also considered nonattainment as a direct result of

overwhelming transport of O_3 from the San Joaquin Valley into these regions via air currents (Grewal, 1996, and Waugh, 1996). Therefore, the SJVUAPCD is responsible for preparing plans and addressing attainment issues associated with transport into these counties.

Summaries of recent air quality conditions in the MCAB for specific pollutants of concern in this region are provided below.

Carbon Monoxide. The state and national 8-hour CO standards were exceeded only recently for the MCAB, in 1993 and 1994. The 1-hour CO concentration has never exceeded the state or national standards.

Ozone. Between 1988 and 1994, O_3 concentrations and the number of state and national violations in the MCAB have generally increased due to pollutant transport. The MCAB had 54 violations of the state O_3 standard in 1992, and 57 in 1994.

Nitrogen Dioxide. NO_2 was not monitored for the MCAB, so no data are presented or discussed here.

Particulate Matter. Air quality in the MCAB appears to be steadily exceeding the state PM_{10} standards with some exceedences of the national standard in 1990 and 1991. The number of days exceeding the state PM_{10} standard has fluctuated from 20 to 40 days per year since 1988.

Sulfur Dioxide. SO_2 was not monitored for the MCAB, so no data are presented or discussed here.

Lead. Lead was not monitored for the MCAB, so no data are presented or discussed here.

SAN FRANCISCO BAY AREA AIR BASIN

Climate and Meteorology

The climate of the San Francisco Bay Area generally consists of mild, rainy weather during the winter and warm, dry weather from June through September. Most of the rainfall occurs during late fall and early spring (November to April) with little or no precipitation occurring from late spring to early fall. The high rainfall frequency between November and April is associated with Pacific storms.

Prevailing winds for the San Francisco Bay Area are from the northwest flowing inland from the ocean. During the winter, a southerly flow pattern predominates with southeasterly winds occurring in the day and calm winds in the late evening and early morning hours. During the spring and summer seasons, the predominant flow pattern is moderate to strong northwesterly wind. Weak northwesterly winds predominate in the fall (California ARB, 1984).

In summer, the Pacific high-pressure system typically remains near the coast, diverting storms to the north. Subsidence of warm air associated with the Pacific high pressure system creates frequent summer atmospheric temperature inversions. Inversions may be several hundred to

several thousand feet deep, effectively trapping pollutants in a small volume of air near the ground.

Recent Air Quality Conditions

The air quality of the SFBAAB is overseen by the Bay Area Air Quality Management District (BAAQMD). The counties of the SFBAAB located in the Sacramento River Region of the PEIS Study Area are Contra Costa and Napa counties, and the western portion of Solano County. The SFBAAB is designated nonattainment with respect to state O_3 and PM_{10} standards (California ARB, 1996). Between 1990 and 1992, the SFBAAB was in attainment with the state and federal standards, and USEPA had approved the SFBAAB as attainment and exempt from preparing any future attainment plans.

However, in 1993, some areas of the SFBAAB exceeded the state standards and discussions are underway to determine the future actions needed by the SFBAAB. In 1993, BAAQMD, the Association of Bay Area Governments (ABAG), and the Metropolitan Transportation Commission (MTC) prepared a maintenance plan that outlined measures to maintain the national and state clean air standards. The Maintenance Plan discussed attainment with O_3 precursors, NO_X and ROG.

In 1995, the SFBAAB was redesignated as attainment for the National O_3 standards. The SFBAAB has not prepared a PM_{10} attainment plan, but discussions are ongoing with USEPA to determine if a plan is required (Marshall, 1996).

The BAAQMD used analytical models to predict emissions to the year 2005. With the existing control measures, the emissions forecasted for the year 2005 are 165 tons per day for ROG, which is below the projected attainment level. New control measures outlined in the Maintenance Plan include reduction in ROG emissions by minimizing emissions from manufacturing and handling of architectural coatings, emulsified and liquid asphalts, and aerosol paint coatings; minimizing emissions from solvent cleaning operations, valves and flanges at petroleum refinery complexes, graphic arts printing and coating operations, pump and compressor seals at petroleum refineries, solid waste disposal sites, natural gas and crude oil production facilities, motor vehicles and mobile equipment coating operations, and marine tank vessel loading; and the California ARB motor vehicle program to reduce ROG and NO_X emissions from vehicles, which includes basic inspection and maintenance programs.

Summaries of recent air quality conditions in the SFBAAB for specific pollutants of concern in this region is provided below.

Carbon Monoxide. CO standards are routinely exceeded in the SFBAAB, but concentrations appear to be declining (BAAQMD, 1992). In general, the number of days each year over the national and state CO 8-hour standard in the SFBAAB declined in the early 1990s and, since 1986, the SFBAAB has not met or exceeded the state 1-hour standard. Mobile sources accounted for approximately 92 percent (2,600 tons/day) and 90 percent (2,900 tons/day) of total CO emissions in 1983 and 1990, respectively (California ARB, 1986 and California ARB, 1990). For 1993, less than 70 percent of CO emissions are estimated to be from mobile sources (BAAQMD, 1992).

Ozone. In the SFBAAB, the number of days over the national and state O_3 standard in the SFBAAB has decreased since 1980. Average O_3 concentrations have also decreased over the same period, although the standard was far exceeded on certain days (BAAQMD, 1992). O_3 precursors in the SFBAAB are mostly mobile source-related. Mobile sources contributed approximately 72 percent (370 tons/day) and 75 percent (460 tons/day) of total NO_X in 1983 and 1990, respectively. ROG has been contributed almost evenly by mobile and stationary sources. In 1983, mobile sources emitted approximately 59 percent (380 tons/day) of the total ROG. In 1990, stationary sources emitted approximately 53 percent (460 tons/day) of total ROG. Thus, the mobile source ROG contribution decreased while its NO_X contribution increased. Natural sources and farming operations were the largest stationary sources of ROG in 1990 (California ARB, 1990).

Nitrogen Dioxide. The average NO_2 concentrations have been consistently below the national and state standard.

Particulate Matter. Since 1986, PM_{10} concentrations have exceeded state standards each year, but only national standards have only been exceeded from 1989 to 1991. Because PM_{10} data are limited for the SFBAAB, a trends analysis is not possible. Stationary sources are estimated to account for approximately 90 percent (360 tons/day) and 90 percent (400 tons/day) of total PM_{10} emissions in 1983 and 1990, respectively. The largest contributors in both years were road dust, construction and demolition, and fires (ARB, 1986 and 1990). The agricultural contribution of PM_{10} is much smaller in the SFBAAB than in the Central Valley.

Sulfur Dioxide. Maximum SO_2 concentrations have consistently remained below state standards; however, the national standard has been exceeded.

Lead. Lead concentrations decreased from 1987 to 1994. The national and state Lead standards were never exceeded in the SFBAAB.

CHAPTER III
ENVIRONMENTAL CONSEQUENCES

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Chapter III

ENVIRONMENTAL CONSEQUENCES

This chapter compares the impacts of Alternatives 1 through 4 to the No-Action Alternative with respect to air quality conditions in the study area.

IMPACT ASSESSMENT METHODOLOGY

Impacts to air quality from agricultural land use changes are dependent upon changes in cropping patterns that may result in (1) increased fallowed lands with increased wind erosion potential, and (2) decreases in pesticide/fertilizer application. The changes in cropping patterns are discussed in the Agricultural Economics and Land Use Technical Appendix. Because the alternatives do not result in major changes in irrigated acreage in other portions of the Study Area, the impact assessment associated with air quality is focused on the Central Valley portion of the Study Area.

As discussed in Chapter II, air pollutants typically associated with urban and industrial uses are not discussed in this technical appendix because it is anticipated that urban land use conditions would not be affected by CVPIA actions. A discussion of M&I land uses, and potential impacts are discussed in the Municipal and Industrial Land Use Technical Appendix.

NO-ACTION ALTERNATIVE

In the No-Action Alternative, agricultural land uses in the Central Valley would include similar crops and cropping patterns as those described in the Affected Environment. It is assumed that retired or fallowed lands would be reseeded with grasses and grazed by livestock or occasionally dryland farmed, as discussed in the Vegetation and Wildlife Technical Appendix. These cultivation measures are similar to methods used on lands that have been historically fallowed due to crop rotation or periodic cropping pattern changes.

It is also assumed that current policies and practices of regulatory agencies would continue at the present level of intensity. This would include the continuation of air quality monitoring and air quality compliance programs. As discussed in Chapter II, these programs have targeted specific emissions categories in past years, and are associated with reductions of specific pollutants in the Central Valley. It is not known, however, the extent to which air quality conditions would be further affected by the continuation of these programs through the year 2022. Therefore, because the cultivated and fallowed acreage patterns are similar to historical patterns, it is anticipated that air quality under the No-Action Alternative would be similar to recent conditions described in the Affected Environment.

ALTERNATIVE 1

An overall reduction in irrigated acreage under Alternative 1 as compared to the No-Action Alternative would be less than 1 percent of the irrigated acreage in the Central Valley. It is assumed that the lands to be retired or fallowed would be reseeded with grasses and grazed by livestock or occasionally dryland farmed, as discussed in the Vegetation and Wildlife Technical Appendix. These cultivation measures are similar to methods used on lands that have been historically fallowed due to crop rotation or periodic cropping pattern changes. Therefore, due to limited changes in land use it is anticipated that the level of wind erosion potential would not increase under Alternative 1 as compared to the No-Action Alternative.

The retirement and fallowing of land would also be associated with reductions in the use of farm equipment and application of pesticides and fertilizers. However, because the percentage of land that would be affected by these changes is small, it is anticipated that air quality conditions resulting from vehicle emissions and pesticide and fertilizer use would not change under Alternative 1 as compared to the No-Action Alternative.

ALTERNATIVE 2

The overall reduction in irrigated acreage under Alternative 2 as compared to the No-Action Alternative would be less than 2 percent of the irrigated acreage in the Central Valley.

It is assumed that the lands to be retired or fallowed would be reseeded with grasses and grazed by livestock or occasionally dryland farmed, as discussed in the Vegetation and Wildlife Technical Appendix. These cultivation measures are similar to methods used on lands that have been historically fallowed due to crop rotation or periodic cropping pattern changes. Therefore, due to relatively minor changes in land use it is anticipated that the level of regional wind erosion potential would not increase under Alternative 2 as compared to the No-Action Alternative. However, the potential for localized areas of increased PM_{10} concentrations should be evaluated in tiered documentation associated with water acquisition.

The retirement and fallowing of land would also be associated with reductions in the use of farm equipment and application of pesticides and fertilizers. However, because the percentage of land that would be affected by these changes is small, it is anticipated that air quality conditions resulting from vehicle emissions and pesticide and fertilizer use would not change under Alternative 2 as compared to the No-Action Alternative.

ALTERNATIVE 3

The overall reduction in irrigated acreage under Alternative 3 as compared to the No-Action Alternative would be less than 3 percent of the irrigated acreage in the Central Valley.

It is assumed that 85 percent of the lands to be retired or fallowed would be reseeded with grasses and grazed by livestock or occasionally dryland farmed, as discussed in the Vegetation and Wildlife Technical Appendix. These cultivation measures are similar to methods used on lands

that have been historically fallowed due to crop rotation or periodic cropping pattern changes. The remaining 15 percent of the lands to be fallowed are assumed to be included in a conservation easement and managed to improve wildlife habitat, especially near refuges.

Due to relatively minor changes in land use with respect to the Central Valley, the inclusion of conservation easements for 15 percent of the land to be fallowed, it is anticipated that the level of regional wind erosion potential would not increase under Alternative 3 as compared to the No-Action Alternative. However, the potential for localized areas of increased PM_{10} concentrations should be evaluated in tiered documentation associated with water acquisition.

The retirement and fallowing of land would also be associated with reductions in the use of farm equipment and application of pesticides and fertilizers. However, because the percentage of land that would be affected by these changes is small, it is anticipated that air quality conditions resulting from vehicle emissions and pesticide and fertilizer use would not change under Alternative 3 as compared to the No-Action Alternative.

ALTERNATIVE 4

The overall reduction in irrigated acreage under Alternative 4 as compared to the No-Action Alternative would be approximately 3 percent of the irrigated acreage in the Central Valley.

It is assumed that 85 percent of the lands to be retired or fallowed would be reseeded with grasses and grazed by livestock or occasionally dryland farmed, as discussed in the Vegetation and Wildlife Technical Appendix. These cultivation measures are similar to methods used on lands that have been historically fallowed due to crop rotation or periodic cropping pattern changes. The remaining 15 percent of the lands to be fallowed are assumed to be included in a conservation easement and managed to improve wildlife habitat, especially near refuges.

Due to relatively minor changes in land use with respect to the Central Valley, the inclusion of conservation easements for 15 percent of the land to be fallowed, it is anticipated that the level of regional wind erosion potential would not increase under Alternative 4 as compared to the No-Action Alternative. However, the potential for localized areas of increased PM_{10} concentrations should be evaluated in tiered documentation associated with water acquisition.

The retirement and fallowing of land would also be associated with reductions in the use of farm equipment and application of pesticides and fertilizers. However, because the percentage of land that would be affected by these changes is small, it is anticipated that air quality conditions resulting from vehicle emissions and pesticide and fertilizer use would not change under Alternative 4 as compared to the No-Action Alternative.

CHAPTER IV

BIBLIOGRAPHY

Chapter IV

BIBLIOGRAPHY

PRINTED SOURCES

Bay Area Air Quality Management District, 1991. Association of Bay Area Governments and the Metropolitan Transportation Commission, Clean Air Plan.

_____, 1992. The History of Ozone in the Bay Area (1970 - 1992), Moving Toward a Cleaner Future.

_____,1993. Air Quality Handbook.

California Air Resources Board, 1974. Climate of the San Joaquin Valley Air Basin. December.

_____, 1975. California Air Basins. December.

_____, 1984. California Surface Wind Climatology. June.

_____, 1986 - 1994. California Air Quality Data, Volumes X-XXVI.

Bay Area Air Quality Management District, Association of Bay Area Governments, and Metropolitan Transportation Commission, 1993a, Final San Francisco Bay Area Non-Attainment Area and Rate of Progress Plan (Attainment Plan) for the National Ozone Standard, adopted September 1993.

_____, 1993b. Final San Francisco Bay Area Redesignation Request and Maintenance Plan (Maintenance Plan) for the National Ozone Standard, adopted September 1993.

_____, 1989b. Emission Inventory 1983. December.

_____, 1989. Emissions Trends for the Sacramento Valley Air Basin. October.

_____, 1990. Emission Trends for the State of California. March.

_____, 1993. Emission Inventory 1990. September.

_____, The California State Implementation Plan for Ozone, Volume 1: Overview of the California Ozone SIP, adopted November 15, 1994.

_____, 1996. Amendments to the Designation Criteria and to the Area Designations for State Ambient Air Quality Standards, Amendments to the San Joaquin Valley and Southeast Desert Air Basin Boundaries, and Maps of Area Designations for the State and National Ambient Air Quality Standards, January.

California Department of Conservation (DOC), 1992. Farmland Conversion Report. October.

Freedman, Bill, 1989. Environmental Ecology.

National Oceanic and Atmospheric Administration (NOAA), 1990. Climatological Data California. Volume 94, Number 5. May.

Rantz, S.E., 1969. Mean Annual Precipitation in the California Region, USGS Open File Map.

Reclamation Projects Authorization and Adjustment Act, 1992. Section 3409. October 30.

Sacramento Metropolitan Air Quality Management District (SMAQMD), 1991. Sacramento 1991 Air Quality Attainment Plan.

_____, 1993. Rate of Progress Plan for Ozone, Volume II.

San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD), 1992. 1991 Air Quality Attainment Plan. January.

_____, 1993. Proposed Final Rate of Progress Plan, September 2.

_____, 1994a. The Ozone Attainment Demonstration Plan, November 3.

_____, 1994b. 1994 Serious Area PM_{10} Plan, September 14.

_____, 1995. Revised Post 1996 Rate of Progress Plan, September 20.

University of California at Berkeley. Division of Agricultural Sciences. Average Daily Air Temperature and Precipitation in California. No date.

PERSONAL COMMUNICATIONS

Banderson, Noel, Air Pollution Control Offices, Amador County Air Pollution Control District. 1996 telephone conversation, April 9.

Brennan, Janet, 1993. Senior Planner, Monterey Bay Unified Air Pollution Control District. 1993 telephone conversation, August 13.

El Dorado County Air Pollution Control District, Feather River Air Quality Management District, Placer County Air Pollution Control District, Sacramento Metropolitan Air Quality Management District, Yolo-Solano Air Quality Management District, 1994, Sacramento Area Proposed Regional Ozone Attainment Plan: Revised October 19.

Grewal, Lokhmir, Air Pollution Control Officer, Calaveras County Air Pollution Control District, 1996. Telephone conversation, April 10.

Hill, Rod, Air Pollution Control Officer, Northern Sierra Air Quality Management, 1993. Telephone conversation, March 29.

Johnson, Richard Air Pollution Control Officer, Placer County Air Pollution District. 1996 telephone conversation, April 12

Kharazi, Ty, 1993. Toxic Assessment Supervisor, San Joaquin Valley Unified Air Pollution Control District. 1993 telephone conversation, December 19.

Kussow, Michael, 1993. Professional Engineer, Shasta County Air Quality Management District. 1993 telephone conversation December 19.

Maertz, Ron, 1993. Senior Air Quality Planner, Sacramento Metropolitan Air Quality Management District. 1993 telephone conversation, December 30.

Marshall, David, Supervising Environmental Planner, Bay Area Air Quality Management District, 1996. Telephone conversation, April 11.

Montez, Norma, 1993. Publications Director, California Air Resources Board. 1993 telephone conversation, November 29.

Northern Sacramento Valley Air Basin, n.d., 1994 Air Quality Attainment Plan.

Rodeman, Sally, Associate Air Pollution Control Officer, Mariposa County Air Quality Management District. 1996 telephone conversation, April 9.

Rothenberg, Mike, 1993. Advanced Project Advisor, Bay Area Air Quality Management District. 1993 telephone conversation, January 3.

Sacramento Metropolitan Air Quality Management District, 1996, AIR liner, 1:2.

Tholen, Greg, Associate Air Quality Planner, SMAQMD, 1996. Telephone conversation, April 9.

Vandagriff, Carl, Senior Planner, Yolo Solano Air Pollution Control District. 1993 telephone conversation, December 30.

_____, 1996. Telephone conversation, April 9.

Wolfe, Clifford, 1993. Senior Environmental Planner, PM_{10} Division, San Joaquin Valley Unified Air Pollution Control District. 1993 telephone conversation, December 21.

Waugh, Mike, Deputy, Air Pollution Control Officer, Tuohemne County Air Pollution Control District, 1996. Telephone conversation, April 11.

CENTRAL VALLEY PROJECT IMPROVEMENT ACT
PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

DRAFT TECHNICAL APPENDIX

Cultural Resources

September 1997

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LIST OF ABBREVIATIONS AND ACRONYMS

ACHP	Advisory Council on Historic Preservation
AFRP	Anadromous Fish Restoration Program
AIRFA	American Indian Religious Freedom Act
APE	Area of Potential Effect
BP	Before Present (Typically prior to 1950)
CA	Circa
CCTS	Central California Taxonomic System
CRHR	California Register of Historical Resources
CSU	California State University
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
EIR	environmental impact report
EIS	environmental impact statement
NAGPRA	Native American Graves Protection Repatriation Act
NAHC	Native American Heritage Commission
NEPA	National Environmental Policy Act
NHL	National Historic Landmark
NHPA	National Historic Preservation Act
NRHP	National Register of Historic Places
OHV	off-highway vehicle
PA	Programmatic Agreement
PEIS	Programmatic Environmental Impact Statement
RBDD	Red Bluff Diversion Dam
Reclamation	U.S. Bureau of Reclamation
Service	U.S. Fish and Wildlife Service
SHPO	California State Historic Preservation Officer
SWP	State Water Project
TCPs	traditional cultural properties
USGS	U.S. Geological Survey

CHAPTER I

INTRODUCTION

Chapter I

INTRODUCTION

The Draft Programmatic Environmental Impact Statement (PEIS) summarizes the evaluation of the direct and indirect impacts of implementing a wide range of actions identified in the Central Valley Project Improvement Act (CVPIA). Details of the information used in the definition of the affected environment and analysis of the environmental consequences are presented in the technical appendices of the Draft PEIS.

This technical appendix presents a summary of cultural resources background information that was used during the PEIS preparation, and the results of the impact analyses for conditions that occurred throughout the study area, shown in Figure I-1.

The cultural resources analysis was primarily based upon changes in land use that may lead to changes in disturbance of cultural resources, changes in water levels at reservoirs and rivers that may lead to changes in exposure of resources, and changes in visitor use at recreational areas that may lead to changes in disturbance. Information from the Agricultural Economics and Land Use, the Vegetation and Wildlife, the Recreation, and the Surface Water and Facilities Operations technical appendices was used in the cultural resource analyses.

The assumptions and results of the analyses for Alternatives 1, 2, 3, and 4 are presented in this technical appendix and summarized in the Draft PEIS. The assumptions and results of Supplemental Analyses 1a through 1i, 2a through 2d, 3a, and 4a are summarized only in the Draft PEIS. The assumptions related to the cultural resources analyses for Alternatives 1, 2, 3, and 4 are presented in Table I-1. The results of the analyses are presented in Table I-2.

FIGURE I-1
STUDY AREA

TABLE I-1

SUMMARY OF ASSUMPTIONS FOR CULTURAL RESOURCES ANALYSES

Alternative or Supplemental Analysis	Assumption
No-Action Alternative	Municipal, agricultural, and recreational land uses as described in California Department of Water Resources Bulletin 160-93.
1	Changes in cultivated acreage, visitor use of recreational areas, and river and reservoir water elevations are primary factors that would affect cultural resources.
2	Same as Alternative 1.
3	Same as Alternative 1.
4	Same as Alternative 1.

TABLE I-2

SUMMARY OF IMPACT ASSESSMENT OF CULTURAL RESOURCES

Affected Factors	No-Action Alternative	Alternative 1	Alternative 2	Alternative 3	Alternative 4
		Change from No-Action Alternative			
Reservoirs	Similar to existing conditions	Potential for increased exposure and increased vandalism at New Melones Reservoir due to low water levels in some water years	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Rivers	Similar to existing conditions	Adverse: Potential for disturbance due to construction of habitat improvements and operational changes that affect water levels	Same as Alternative 1	Same as Alternative 1, plus additional potential for disturbance on Stanislaus River due to increased recreational use	Same as Alternative 3
Refuges	Similar to existing conditions	Adverse: Potential impacts due to increased flooding and erosion	Greater adverse impacts than under Alternative 1	Same as Alternative 2	Same as Alternative 2
Cultivated Lands	Similar to existing conditions	Similar to No-Action Alternative	Benefit: Reduced exposure due to reduction in cultivated land in the San Joaquin River and Tulare Lake regions	Same as Alternative 2, plus additional benefits in San Joaquin River Region	Same as Alternative 3, plus additional benefits in Sacramento River Region

CHAPTER II

AFFECTED ENVIRONMENT

Chapter II

AFFECTED ENVIRONMENT

INTRODUCTION

This technical appendix describes the sensitivity for prehistoric and historic archeological sites, structures and buildings, architectural properties, ethnographic resources, and historic properties that are eligible for the National Register of Historic Places (NRHP) for each geographic region in the study area. The CVPIA could affect properties that are listed or eligible for listing in the NRHP. The technical appendix was used as background and support information for the PEIS.

This technical appendix does not provide site-specific information for all known cultural resources potentially affected by the CVPIA. Instead, it presents general information on types, density, and significance of cultural resources within the study area. It focuses on known NRHP-eligible or NRHP-listed sites and other significant resources. Cultural resources in the Central Valley are described in the most detail because most of the CVP facilities are in the Central Valley.

The CVPIA requires NEPA review and compliance with Section 106 of the National Historic Preservation Act (NHPA). Compliance with Section 106 is described in "Regulatory Framework."

The remainder of this section defines cultural resources, discusses the regulatory framework for addressing cultural resources for the implementation of the CVPIA, describes how areas are assessed to determine whether they are sensitive for cultural resources and how resource significance is determined, and describes the study area.

DEFINITION OF CULTURAL RESOURCES

For the purposes of this technical appendix, cultural resources are defined as prehistoric and historic archeological sites, architectural properties (e.g., buildings, bridges, and structures), and traditional properties with significance to Native Americans. This definition includes historic properties as defined by the NHPA.

REGULATORY FRAMEWORK

National Historic Preservation Act

In addition to meeting the requirements of NEPA, the CVPIA requires compliance with Section 106 of the NHPA of 1966, as amended and its implementing regulations, 36 CFR Part 800. Section 106 requires that federal agencies take into account the effects of their actions on properties that may be eligible for or listed in the NRHP. To determine whether an undertaking

could affect NRHP-eligible properties, cultural resources (including prehistoric and historic archeological sites and structures, buildings, and ethnographic resources)) must be inventoried and evaluated for the NRHP.

The Section 106 review process is implemented according to the following steps.

(1) Historic properties are identified and evaluated.

(2) The effects of the undertaking on properties that are eligible for the NRHP are assessed.

(3) The State Historic Preservation Officer and other agencies are consulted for the development of an agreement that addresses the treatment of historic properties.

(4) Advisory Council on Historic Preservation (ACHP) comments on the agreement or results of consultation are received.

(5) The project proceeds according to the conditions of the agreement.

Compliance with Section 106 for implementation of the CVPIA will occur on a project-by-project basis in accordance with 36 CFR 800.4-800.6 and will be implemented once the locations of CVPIA-related activities are known.

American Indian Religious Freedom Act

Implementation of the CVPIA must also take into consideration the requirements of the American Indian Religious Freedom Act (AIRFA), enacted in 1978. AIRFA states:

> it shall be the policy of the United States to protect and preserve for American Indians their inherent right of freedom to believe, express, and exercise the traditional religions of the American Indian, . . . including but not limited to access to sites, use and possession of sacred objects, and the freedom to worship through ceremonial and traditional rites.

Native American Graves Protection and Repatriation Act

When CVPIA-related activities are conducted on federal land and those activities result in the discovery of Native American burials, associated or unassociated funerary objects, compliance with the Native American Graves Protection and Repatriation Act (NAGPRA) of 1990 is required. NAGPRA establishes procedures to determine the ownership and disposition of Indian and native Hawaiian human remains, funerary objects, sacred objects, or objects of cultural patrimony discovered on federal lands. The law establishes penalties for persons convicted of illegal trafficking in Native American human remains and cultural items, requires federal agencies to inventory their collections of human remains and associated or unassociated funerary objects, determine ownership, and repatriate cultural items in accordance with the provisions of the law.

DETERMINATION OF RESOURCE SENSITIVITY

In areas where existing information on the location and types of cultural resources is limited, it is necessary to assess the sensitivity of an area's cultural resources to determine how the CVPIA will affect them (National Park Service, 1985). Assessment of an area's cultural resources sensitivity requires information on where resources have been found previously, as well as an understanding of broad patterns in prehistory and history that have influenced the location and density of resources. The factors that affect prehistoric- and historic-period resource locations are often quite different, and each area is discussed separately.

Many prehistoric resource locations can be predicted using environmental variables, because prehistoric occupation and use of the landscape was primarily based on subsistence needs. Understanding how and where necessary resources, such as water, food, and shelter, were obtained by prehistoric populations permits predictions to be made about where sites might be found. These predictions are confirmed by comparing the suspected site locations with known location site data and archeological survey results. This information is combined with environmental data to develop a prehistoric archeological sensitivity model. These models can be used to predict where certain types of sites can be found in a region.

Another source of information that can be used in determining prehistoric resource location is information obtained from ethnographic research. Although this research was conducted during the historic period, ethnographies often contain information about the period prior to Euroamerican entry into California. Information on hunting and gathering practices, religious ceremonies, and village locations and tribal organization is often contained in ethnographic sources that are pertinent to developing models of prehistoric archeological sensitivity.

Although many above ground historical sites have been identified, predicting the locations of some types of historic resources requires an understanding of the national, regional, and local historical themes that influenced historic settlement in California. Most of these themes focus on one type of economic endeavor or another. Some areas are influenced by multiple historical themes. For example, much of the Sierra Nevada foothills contain gold-bearing deposits and this region was the focus of a major gold rush during the mid-19th century. This region was also the site of early logging, railroad, ranching, and recreational activities. To assess the historic resource sensitivity of this region, it would be necessary to identify these broad themes and then conduct more detailed documentary research at the local level. Using the historical data and knowledge of existing historic resource location, a model of historic resource sensitivity can be developed. These types of models can be tested and developed as survey data become available.

DETERMINATION OF RESOURCE SIGNIFICANCE

Federal and state processes and programs assess the significance of cultural resources. These programs evaluate the significance of the resources against established criteria, and those resources meeting program criteria are designated as significant. The following describes the significance criteria and programs that contributed to the "Affected Environment" section.

National Register of Historic Places

For federal projects, the significance of cultural resources is assessed based on NRHP eligibility criteria. Under these criteria, cultural resources are considered significant if districts, sites, buildings, structures, and objects of significance in American history, architecture, archeology, engineering, and/or culture possess integrity of location, design, setting, materials, workmanship, feeling, and/or association, and:

(a) are associated with events that have made a significant contribution to the broad patterns of our history; or

(b) are associated with the lives of persons significant in our past; or

(c) embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or possess high artistic values, or represent a significant and distinguishable entity whose components may lack individual distinction; or

(d) have yielded, or may be likely to yield, information important in prehistory or history (36 CFR 60.4).

For a property to be eligible for listing in the NRHP or be listed in the NRHP, it must meet one of the criteria for significance (36 CFR 60.4 [a, b, c, or d]) and retain integrity. Integrity is defined as "the authenticity of a property's historic identity, evidenced by the survival of physical characteristics that existed during the property historic or prehistoric period" (National Park Service, 1982). NRHP-eligible properties must retain at least two of seven types of integrity, including integrity of location, design, setting, materials, workmanship, feeling, and association. Properties can be eligible for the NRHP at the local, state, or national level.

Although archeological sites may appear to be significantly damaged on the surface from activities such as agriculture or development, it is often the case that below the surface they retain sufficient integrity to meet NRHP eligibility criteria. To determine whether an archeological site retains integrity below the surface, it is often necessary to conduct archeological test excavations. Generally, properties must be at least 50 years old to be eligible for the NRHP; however, resources that are of exceptional significance can be eligible for the NRHP even if they are less than 50 years old.

Traditional cultural properties (TCPs) are one of the types of properties that are eligible for the NRHP. Such properties derive their significance not from the property itself; instead, they derive significance from the role the property plays in the cultural practices or beliefs of an extant community or identifiable social group. Examples of TCPs range from expansive geographic areas such as Burney Falls (which is well documented for its cultural importance to Native Americans) to individual structures or locations associated with beliefs or practices that are of traditional cultural significance. The evaluation of TCP significance is conducted with the same set of NRHP criteria as for other historic property types. For a property to be determined significant as a TCP, it must be tangible.

National Historic Landmark

The National Historic Landmark (NHL) program was established by the Historic Sites Act of 1935. An NHL can be a district, site, building, structure, or object that the Secretary has determined possesses exceptional value in commemorating or illustrating the history of the United States. Properties are designated as NHLs only if they are nationally significant.

California Historical Landmarks

The California Historical Landmarks program recognizes properties that are of statewide historical importance to California. Historical Landmark registration recognizes the following historical influences: anthropological, cultural, military, political, architectural, economic, scientific and technical, religious, and experimental. Properties that have been designated California Historical Landmarks 770 and higher are automatically included in the California Register of Historical Resources (CRHR).

California Points of Historical Interest

The California Points of Historical Interest recognizes properties and localities that are of local, city, or county interest. The criteria for designation are generally the same as those used for the state Historical Landmarks program.

California Register of Historical Resources

The CRHR provides a comprehensive listing of California's historical resources. To be listed in the CRHR, a property must be deemed significant at the local, state, or national level, under one or more of the following criteria:

- It is associated with events that have made a significant contribution to the broad patterns of California's history and cultural heritage.
- It is associated with the lives of persons important in our past.
- It embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of an important creative individual, or possesses high artistic values.
- It has yielded, or may be likely to yield, information important in prehistory or history.

The determination that resources meet one or more of these criteria often requires extensive research. For prehistoric- and historic-period archeological sites, it is usually necessary to conduct text excavations to determine whether the sites meet the significance criteria and retain integrity. For buildings, structures, and TCPs, it is often necessary to conduct detailed, site-specific documentary research or conduct oral history interviews to apply the criteria.

Properties listed in the CRHR are not listed in this appendix because the CRHR had not been established when research for the CVPIA PEIS was initiated. The CRHR should be consulted, however, when individual projects to implement the CVPIA are proposed.

STUDY AREA

The study area used for the description of the affected environment for the Cultural Resources Technical Appendix differs somewhat from the generalized study area presented in Chapter I. The study area has been divided into six regions: the Sacramento River Region, the San Joaquin River Region, the Tulare Lake Region, the North Coast Region, the Central Coast Region, and the San Francisco Bay Region.

These regions differ from those presented in Chapter I and Figure I-1 in the following ways:

- The South Coast and Trinity River Basin regions were not included.
- The regional boundaries along the west slope of the Sierra Nevada have been adjusted to include reservoirs that may be affected by the CVPIA alternatives.

The South Coast and Trinity River Basin regions were not included because no information was available to allow an analysis of effects of the CVPIA alternatives on these regions. The inclusion of the Delta in the Sacramento River and San Joaquin River regions reflects the fact that prehistoric and historic information on cultural resources is generally available by county; therefore, the regions were configured to conform to county boundaries. The boundary along the west slope of the Sierra Nevada was adjusted to include reservoirs that may be affected by the CVPIA alternatives.

Sacramento River Region

The Sacramento River Region consists of all or portions of Amador, Butte, Colusa, El Dorado, Glenn, Napa, Nevada, Placer, Sacramento, Shasta, Solano, Sutter, Tehama, Yolo, and Yuba counties. The Sacramento River divides this region into the east side and west side.

This region is rich in historic- and prehistoric-period resources. Considerable archeological research has been conducted in the area, including early work defining central California's prehistory. Of particular importance are the large, deep midden sites, which provide information on prehistoric culture extending over thousands of years. In the foothills, middens, lithic scatters, and bedrock mortars predominate. Historic archeological sites and architectural resources are plentiful because this area was settled early in California's history. As in other areas in the Central Valley, resources related to agricultural development are prevalent.

San Joaquin River Region

The San Joaquin River Region consists of all or portions of Calaveras, Fresno, Madera, Mariposa, Merced, San Joaquin, Stanislaus, and Tuolumne counties. The San Joaquin River and Fresno Slough divide this region into eastern and western subregions.

The valley floor of this region contains many of the same type of historic- and prehistoric-period resources found in the southern Sacramento Valley. In the foothills, the numerous prehistoric sites reflect a wide variety of occupational and resource procurement activities. Historic sites are primarily related to mining, settlement, and agricultural pursuits.

Tulare Lake Region

The Tulare Lake Region includes all of Kings County and the western portions of Tulare and Kern counties. State Highway 99 divides the Tulare Lake Region into eastern and western subregions.

Prehistoric resources in the Tulare Lake Region are similar to those found in the Delta Region. Both areas contain large, deeply stratified sites dating back thousands of years; however, considerably less archeological research has been conducted in this region. Prehistoric sites in the southern Sierra are quite similar to those in the foothills of the San Joaquin Valley. Historic-period resources are dominated by agricultural settlement.

North Coast Region

The North Coast Region includes all or portions of Del Norte, Humboldt, Mendocino, Trinity, and Sonoma counties. The Trinity River Basin is not discussed separately from the North Coast Region. The prehistory of the North Coast Region is not as well known as that of other parts of California because there has been less development pressure in the area and, consequently, less cultural resources research. The limited research indicates that prehistoric archeological sites date back in excess of 8,000 years and, despite the rugged terrain, are densely distributed on ridges and terraces. Historic sites are primarily the result of logging, mining, and fishing endeavors.

Central Coast Region

The Central Coast Region includes San Benito County. No CVP facilities are located within this region, although the CVPIA may affect offshore fisheries. Therefore, cultural resources are only generally described for this region.

Prehistoric sites are common along the coast, where research activities focus on the collection of coastal resources. Spanish- and Mexican-era resources are in the area, as well as the remains of early day logging, fishing, and agricultural pursuits.

San Francisco Bay Region

The San Francisco Bay Region includes all of Marin, San Francisco, San Mateo, Santa Clara, and Alameda counties and a portion of Contra Costa County.

STUDY PERIOD

The information used for this study was collected between 1993 and 1996 and covers the period between 1900 and the present. Information pertains to resources that date to the early historic and prehistoric periods. An historical perspective of changes in cultural resources between 1850 and 1990 is presented following this section. "Historical Perspective" provides an overview of historic events that resulted in changes to cultural resources following the gold rush and implementation of the CVP.

DATA SOURCES

Information was collected on known prehistoric and historic archeological sites and architectural resources (e.g., buildings and structures). Ethnographic information was obtained from the Native American Heritage Commission (NAHC) and from ethnographic literature. Data were collected using published or readily accessible unpublished sources.

COORDINATION WITH OTHER ISSUES

This technical appendix was coordinated with sections describing the economic effects of the CVPIA on Native American tribes and on Native American Trust Lands. Economic issues affecting Native American Tribes and Native American Trust Lands are discussed in the PEIS and the physical manifestations of cultural activities are discussed in the following sections.

PREHISTORIC AND HISTORIC ARCHEOLOGICAL RESOURCES

Primary repositories for information on cultural resources are the regional information centers of the California Historical Resources Information system. The information centers maintain records on resources (both archeological and architectural) listed in the NRHP; resources listed on other state lists, such as the Points of Historical Interest, California Historical Landmarks, and the California Inventory of Historic Resources; known prehistoric and historic archeological sites; known architectural resources; and locations of previous cultural resources investigations.

Limited record searches generally determined where known cultural resources are located in each of the geographic regions. Research was conducted at the following information centers of the California Historical Resources file system:

- Northwest Information Center, Sonoma State University
- Northeast Information Center, California State University (CSU), Chico
- North Central Information Center, CSU, Sacramento
- Central California Information Center, CSU, Stanislaus
- Central Coastal Information Center, University of California, Santa Barbara
- Southern San Joaquin Valley Information Center, CSU, Bakersfield

At each information center, information was sought from the following sources.

- Maps of archeological site locations
- NRHP (listed properties)
- Points of Historical Interest
- California Historical Landmarks
- California Inventory of Historic Resources

HISTORICAL AND ARCHITECTURAL RESOURCES

Primary repositories of information on historical and architectural resources are published lists of resources, Reclamation files, and the regional information centers.

Published lists of resources used to compile data on historical and architectural resources included the NRHP, California Points of Historical Interest, California Historical Landmarks, and the California Inventory of Historic Resources. These data were aggregated by geographic region to provide a general overview of the listed historical and architectural resources of the study area. Information from Reclamation on Shasta and Keswick dams, the CVP facilities that have been determined eligible for the NRHP, was also reviewed.

Resources that are described under the historic and architectural resources sections provide only the types and numbers of resources that have been listed on federal or state historic resources lists for each geographic region. Many more historic and architectural properties have been identified in these regions but have either not been evaluated or have not been listed on formal registers. Information on the types of resources present within each geographic region is based on historic resources themes that were established for these programs. Aboriginal themes are also included because some historic resources also have prehistoric components.

Research was conducted at the following five information centers containing data for counties with CVP facilities:

- Northwest Information Center, Sonoma State University, Rohnert Park
- Northeast Information Center, CSU, Chico
- North Central Information Center, CSU, Sacramento
- Central California Information Center, CSU, Stanislaus
- Southern San Joaquin Valley Information Center, CSU, Bakersfield

At these centers, more than 150 U.S. Geological Survey (USGS) maps were reviewed to determine the presence of historical and architectural resources near CVP facilities (e.g., dams, lakes, pumping stations, and canals). In addition, site records and any other supplemental information compiled by the information centers were reviewed where listed historical and architectural resources were identified within 150 feet of a CVP facility.

NATIVE AMERICAN RESOURCES

Information on areas of importance to Native Americans was solicited from the NAHC's Sacred Lands files. Published ethnographic sources were also reviewed for information on the ethnographic use of geographic areas within the study area.

Information obtained on ethnographic resources within the CVPIA study area is contained in Attachment A.

DATA LIMITATIONS

Archeological Data

Prehistoric and ethnographic summaries are based on widely available sources, which have often been updated by more recent research. These up-to-date sources are often unpublished, however, making their use infeasible for this study.

Many parts of California have been inventoried much more extensively than others. As a result, the number of known resources usually depends on the amount of research that has been conducted rather than on actual site density.

The data base is also biased in terms of site types because historic sites were not commonly recorded until the 1970s, resulting in an inaccurate ratio of historic to prehistoric sites. In addition, many information centers do not keep separate tabulations for historic and prehistoric sites; this information could be provided only for counties in which the small number of sites permitted manual tabulation.

Many information centers have incomplete data bases because of backlogs in processing and the failure of individuals or agencies to submit site records and reports. For the most part, information contained in backlogs could not be accessed for this technical appendix.

Because information centers do not calculate the amount of land that has been surveyed for cultural resources, only rough estimates of the percentage of the county surveyed are provided. These figures should be used only for a relative comparison of counties.

Concerning estimates of disturbance, many USGS maps are outdated and do not show where massive disturbance has resulted from farming (i.e., Tulare Basin) or where new development has occurred.

Historical and Architectural Data

Historical and architectural resource data are incomplete for many of the same reasons discussed previously. Specifically, the type and amount of historical and architectural resource data available are dictated by the previous research conducted in a specific geographic area. Not every community or county has prepared comprehensive historical and architectural resource inventories, and the resources may appear in published sources because they have been studied in

association with a proposed development or because a special-interest group has provided the necessary information. The lists are not comprehensive and only represent the types of historical and architectural resources in any given geographic area.

In some cases, inconsistent information collection has resulted in data limitations. For example, data were not collected for resources determined eligible for listing in the NRHP because this information could not be collected for each county or geographic area.

Finally, some information collected may be outdated. As an example, some historical and architectural resources may not have been eligible for listing in the NRHP when a study was conducted because they were not yet 50 years old (the generally accepted minimum age of resources eligible for the NRHP). It is possible that some resources have now reached the minimum age for eligibility.

Ethnographic Data

Information was sought from the NAHC regarding resources identified in its Sacred Lands files; however, because of the sensitivity of this information, the NAHC provided only a general description of the types of resources identified in the study area. Scoping information for the PEIS was also sought from interested Native Americans. These efforts are described in the Public Involvement Technical Appendix.

Ethnographic information from either published sources or knowledgeable individuals varies greatly, depending on whether traditional cultural practices persisted into the historic period. Little information on traditional culture can be found in areas where Euroamerican settlement completely replaced the indigenous population. In comparison, areas continuously occupied by Native American groups often maintain traditional cultural practices. Ethnographic information for the study area is contained in Attachment A.

HISTORICAL PERSPECTIVE

This section provides an overview of the prehistory, history, and ethnography of the CVPIA study area, followed by detailed information on the prehistory, history, and ethnography of each geographic region.

PREHISTORIC CONTEXT OF THE STUDY AREA

The CVPIA study area has a long and complex cultural history with distinct regional patterns that extend back more than 11,000 years. The first generally agreed upon evidence for the presence of prehistoric peoples in the CVPIA study area is represented by the distinctive fluted spear points called Clovis points. These artifacts have been found on the margins of extinct lakes in the San Joaquin Valley. The Clovis points are found on the same surface with the bones of animals that are now extinct, such as mammoths, sloths, and camels. Based on information obtained from sites outside the CVPIA study area, the ancient hunters who used these spear

points existed during a narrow time range between 10,900 B.P. and 11,200 B.P. This span of time is often called the Clovis Period.

The cultural period thought by most researchers to be subsequent to the Clovis Period is another widespread complex, although the indicative artifacts consist of stemmed spear points rather than the fluted points that typify the Clovis Period. This poorly defined early cultural tradition is best known from a small number of sites in the San Joaquin Valley and the Sierra Nevada foothills and is thought to date to 8000 to 10,000 B.P. Practitioners of this cultural tradition may be precursors to the subsequent cultural pattern.

Approximately 8,000 years ago, many California cultures shifted the main focus of their subsistence strategies from hunting to seed gathering as evidenced by the increase in food-grinding implements found in archeological sites dating to this period. This cultural pattern is best represented in southern California, where it has been called the Milling Stone Horizon (Wallace, 1954). Recent studies suggest that this culture pattern is more widespread than originally described and is in fact found throughout the study area. Radiocarbon dates associated with this time period vary between 8000 and 2000 B.P., but cluster in the 6000 to 4000 B.P. range (Basgall and True, 1985).

Cultural patterns as reflected in the archeological record, particularly specialized subsistence practices, became better defined within the last 3,000 years. The archeological record becomes more complex as specialized adaptations to locally available resources were developed and populations expanded. Many sites dated to this time period contain mortars and pestles or are associated with bedrock mortars, implying that the occupants exploited acorns intensively. Also at this time, the range of subsistence resources that were used increased and exchange systems expanded significantly from the previous period. Along the coast and in the Central Valley, archeological evidence of social stratification and craft specialization is indicated by well-made artifacts such as charm stones and beads, which were often found with burials.

OVERVIEW OF HISTORY OF THE STUDY AREA

Each geographic region within the study area has its own specific history; however, several broad historical themes are consistent throughout the regions. These themes include early exploration, settlement, military expansion, mining, agriculture, transportation, and recreation. Most of the historic-period resources that are present in the study area are associated with one of these contexts, which is described in the following discussion.

Initial Euroamerican incursions in the region came in the form of Spanish missionaries and soldiers, who entered California from the south in 1769, eventually founding 21 missions along the California coast. This period is characterized by the establishment of missions and military presidios, the development of large tracts of land owned by the missions, and subjugation of the local Indian population for labor. This way of life began to crumble in 1822, with Mexico winning independence from Spain. Secularization of the missions in 1834-1835 brought the mission period in California history to a close. During the Mexican Period, between 1822 and 1848, the large tracts of land previously held by the missions were divided by government grants into large *ranchos* often consisting of tens of thousands of acres. The owners of these large

estancias built homes, often of adobe, and maintained large herds of cattle and horse. Agriculture during this time was a minor endeavor, usually restricted to garden plots and small vegetable-growing operations.

During the Spanish and Mexican periods, both Russian and American explorers continued to make forays into the region. Fort Ross, which occupied a point on the Sonoma coast from 1812 until 1841, presented a formidable stronghold from which the Russians conducted their hunting, fishing and whaling businesses. American explorer Jedediah Smith and members of the Hudson Bay Company also came to California during the first quarter of the 19th century. The Treaty of Guadalupe Hidalgo in 1848 resulted in the transfer of California from Mexico, ushering in what is called the American Period in California history. During that same year, gold was discovered in the foothills of the Sierra Nevada and thousands of hopeful miners entered the region. On the heels of the miners were storekeepers, settlers, and farmers, all with their sights set on California's fertile land.

This rush of miners and settlers made the development and improvement of a transportation system a virtual necessity. Between 1850 and 1880, California saw the development of hundreds of primary wagon routes, the evolution of steamboat travel along major rivers, and the completion of numerous railroads. Most of the supply centers and shipment points along these transportation corridors eventually developed into cities, small towns, and settlements. Logging in California went hand in hand with settlement as the new arrivals sought building materials for their homes, businesses, and industries.

Like the *Californios* before them, American ranchers found Central California ideally suited for grazing large herds of stock. During the latter part of the 19th century, large tracts of former rancho land were amassed by American ranchers and several great cattle empires were formed.

As settlements grew, agricultural enterprises became more common. During the early years, dry-farming practices predominated. A primary constraint to expansion of crop diversity and areas under cultivation was the lack of water. Irrigation was virtually unknown in California until the 1880s, when large-scale irrigation systems were developed to improve agriculture yields. The basis of these irrigation systems was the many smaller water conveyance systems formerly developed for hydraulic mining. With the development of irrigation, new crops were added to the grains obtained from dry-farming, including vegetables, fruits, and nuts. These new crops came at an ideal time, as the improvements to transportation routes allowed their distribution and the increase in settlements provided a market.

After the turn of the century, California settled into a period of slow growth and increased agricultural productivity and prosperity. With the coming of the automobile age and the establishment of many national parks and other attractions, California came to be viewed as a prime recreational area. Many coastal and mountain resort areas in California have been developed to support recreation, and many local and regional economies are based on recreational activities.

California's favorable economic situation was boosted considerably by the development of the CVP in the 1940s and introduction of more sophisticated farming methods. The result is that today the Central Valley is one of the most important food-supplying regions in the nation.

OVERVIEW OF ETHNOGRAPHY OF THE STUDY AREA

The study area encompasses lands occupied by more than 40 distinct Native American cultural groups. Although most California tribes shared similar elements of social organization and material culture, linguistic affiliation and territorial boundaries primarily distinguish them from each other. Prior to European settlement of California, an estimated 310,000 native Californians spoke dialects of as many as 80 mutually unintelligible languages representing six major North American stocks (Cook, 1976; 1978; Shipley, 1978). This mosaic of languages represents one of the most complex linguistic admixtures on earth and is comparable to few other places except perhaps the Golden Triangle of Southeast Asia or tribal New Guinea (Shipley, 1978; Moratto, 1984). This level of complexity necessitated a high level of multilingualism among the state's native peoples who interacted widely with one another through trade and ceremonial exchanges. Intermarriage across language groups was likewise common. Similar to today, California was demographically very dynamic in prehistoric times, with the highest population density in North America outside the Basin of Mexico. California was home to perhaps one out of every 10 people living in North America during the pre-Columbian era.

California's native peoples have been divided by anthropologists into several so-called "culture areas" based on perceived similarities of environments, lifestyles, and material culture. Six such divisions are generally recognized: the Northwest, Northeast, Central, and Southern California regions, as well as the Colorado River and Great Basin culture areas of the state's southeastern corner and eastern side of the Sierran Range respectively. The culture areas are geographically delineated and are based primarily on those features and shared traits that make their inhabitants more alike than those of neighboring regions. The factors most likely to distinguish one culture area from another are often related to elements of the physical environment, which mold or condition the cultures living within them to a great extent.

All native Californians followed a basic hunter-gatherer lifestyle subsisting through a seasonal round of plant collecting, hunting, and fishing. Then as now, the environment was bountiful and the products of the various regions such as shore, mountain, and desert were often widely traded. Reliance on particular resources varied with location and season. For example, acorns were a staple throughout northern, central, and parts of southern California, but merely a supplement to the diet along the northwestern coast or eastern desert where they could only be obtained by trade. On the northwestern coast and in other areas with streams that ultimately afforded access to the Pacific Ocean, salmon was a generally abundant mainstay. Locally abundant on a seasonal basis, salmon could be dried for storage or trade with groups in other environments. For groups occupying ranges on the eastern side of the Sierra Nevada, the nut of the pinyon pine *(Pinus monophylla)* served a function similar to salmon and acorns in other areas. Archeological evidence indicates a general evolution over time from subsistence strategies that were based primarily on hunting large game to a broad-based economy that placed greater emphasis on diversity. Along with this diversification came population growth and a more settled way of life. Many have argued that California's productive natural environment was so well managed by its

native peoples that crops such as acorns had become the equivalent of the products of agriculture elsewhere on the continent (Bean and Lawton, 1973).

At the time of first contact with Spanish explorers and settlers, most groups inhabiting California had extremely evolved social, ceremonial, and political structures supported by an elaborate and varied material culture. This was especially true of the Central Sacramento-San Joaquin Valley and Southern Coast-Santa Barbara Channel regions, which were exemplified by the Yokuts and Chumash. Most researchers believe that favorable geography and climate; varied, reliable, and storable food sources; and interconnecting trade networks kindled the development of California's cultures beyond that generally exhibited by nonagriculturalist hunter-gatherers.

Native Californians were initially devastated by contact with Europeans, experiencing an unprecedented demographic collapse. This great population loss was brought on by the advent of new diseases for which they had no immunity and hastened by the loss of their land base. As a testament to their resourcefulness and resilience, native culture is experiencing a resurgence today and a revival of traditional practices throughout the state.

RESOURCE INFORMATION

The following discussion provides information on the prehistoric, historic, and ethnographic resources that could be affected by the CVPIA. An attempt has been made to organize the following sections using the geographical regions selected for this study, but cultural phenomena (e.g., settlement patterns and territories) often do not correspond to study area boundaries. In addition, data collection and management by researchers and the information centers often precluded data collection for this PEIS based on the study area geographic boundaries. For example, the territory of ethnographic groups often includes more than one geographical region. In these instances, the ethnographic summary appears under the first geographic region discussed. This discussion is referenced for other geographic regions inhabited by the ethnographic group. Figure II-1 shows the ethnographic boundaries for California Native American groups. Also affecting the organization of this appendix is the fact that prehistoric, historic, and ethnographic data are not strictly segregated. Instead, there is considerable overlap in the way data are collected and managed.

Specifically, most information centers do not maintain tallies of the number of historic and prehistoric sites recorded or which sites contain prehistoric and historic components or both. Because most recorded archeological sites are prehistoric, information for all known archeological sites is provided in the "Prehistoric Resources" section following. Separate tallies for prehistoric and historic sites are provided only for counties in which the number of sites permitted manual counting.

Further, most of the formal resource lists, such as the NRHP, include prehistoric, historic, and ethnographic resources. Because most of the formally listed resources are historic, they are discussed under the "Historic Resources" section following even though tallies include prehistoric and ethnographic resources.

SOURCE: Heizer, 1978.

FIGURE II-1

ETHNOGRAPHIC TERRITORIES OF CALIFORNIA NATIVE AMERICAN GROUPS

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Information on sites of importance to Native Americans was sought from the Sacred Lands files of the NAHC; however, because of the sensitivity of these resources, only a general description of resources was obtained.

The NAHC indicated that all counties in the study area for the CVPIA PEIS could contain burial sites, worship/ritual sites, sacred/power sites, village sites, house pits, lithic scatters, bedrock mortars, and resource collection areas with value to Native Americans. The NAHC recommends that the appropriate Native American groups be contacted for additional information.

Published ethnographic sources were consulted for information on the types and general location of resources that could be of concern to Native Americans during implementation of the CVPIA. The results of this research are documented in Attachment A.

Sacramento River Region

The Sacramento River Region consists of Amador, Butte, Colusa, Glenn, Napa, Sacramento, Shasta, Solano, Sutter, Tehama, Yolo, and Yuba counties and portions of El Dorado, Nevada, and Placer counties. For the prehistoric overview that follows, the west side of the Sacramento Valley is divided into north and south sides because, although the archeological manifestations in these areas are interrelated, they differ in many respects. The ethnography and history overviews are divided into west and east sides of the Sacramento Valley, but the west side of the valley is not further divided into northern and southern areas.

Prehistory of the East Side of the Sacramento Valley. The northern high Sierra Nevada foothills appear to have been first used by Great Basin people around 6000 B.C. By approximately 2000 B.C., people possibly from the Great Basin were seasonally hunting and gathering in the higher elevations and apparently also extended well into the Sacramento Valley. Their material culture has been termed Martis, after the Martis Valley, where they were first recognized.

The northern foothill area, roughly corresponding to the ethnographically known Maidu area, includes four recognized prehistoric archeological phases typical of this subregion, defined by the following complexes (Moratto, 1984): the Mesilla, Bidwell, Sweetwater, and Oroville.

Dating from approximately 1000 B.C. to A.D. 1, the Mesilla Complex is characterized by atlatl points, bowl mortars, various shell beads, charm stones, and bone implements. Sites defining this phase apparently reflect seasonal forays into the foothills for hunting and gathering and appear to indicate Martis influence.

Dating from approximately A.D. 1 to 800, the Bidwell Complex is recognized by milling stones, wooden mortars (inferred), large slate and basalt points, steatite vessels, and flexed burials. The settlement/subsistence pattern appears to have included permanent villages with surrounding task-specific locations (e.g., hunting, fishing, and food processing).

The Sweetwater Complex has been identified as dating from between approximately A.D. 800 to 1500. Traits include certain shell, bead, and ornament forms; steatite cups and other implements;

small projectile points (Eastgate, Rose Spring, and Gunther Barbed types); and extended or semi-extended burials.

The Oroville Complex, A.D. 1500 to 1833, is identified by numerous bedrock mortars, incised bird bone tubes, gorge hooks, gaming bones, clamshell disk beads, circular dance houses, and tightly flexed burials. This phase ended with the malaria epidemic of 1833, which greatly reduced the Maidu population.

Prehistoric Resources—East Side of the Sacramento Valley. The following provides information for prehistoric resources for counties on the east side of the Sacramento Valley.

Amador County. Approximately 358 sites have been recorded within Amador County, 51 of which are historic or have historic components. An estimated 5 percent of county land has been surveyed for cultural resources. Overall, the degree of disturbance may be rated as low, with most of the development in the western half of the county.

Prehistoric sites recorded within Amador County include a milling station, habitation sites, temporary camps, lithic scatters, burials, rock shelter sites, petroglyphs, and pictographs. Recorded sites are found in the highest density along the Mokelumne River and its tributaries, along creeks and ridge flats in the Sierra Nevada foothills, and along small watercourses in the valley.

Butte County. Of the 1,279 sites recorded within Butte County, 81 are historic sites or have historic components. Approximately 10 percent of the county has been surveyed for cultural resources. The overall degree of disturbance in Butte County may be rated as moderately low.

Habitation sites, temporary camps, burials, milling stations, rock shelter sites, lithic scatters, and petroglyphs have been recorded within the county. Recorded sites are found in the highest density along the Sacramento and Feather rivers, along smaller valley watercourses, in oak woodland habitats, and along foothill and mountain creeks and ridge flats.

El Dorado County. Approximately 851 sites have been recorded within El Dorado County. Of these, 256 are historic sites or have historic components. Approximately 5 to 10 percent of the county has been surveyed for cultural resources. The degree of disturbance in the county may be rated as moderate overall and heavy in the western area.

Prehistoric sites include milling stations, lithic scatters, habitation sites, artifact scatters, rock circles, burials, quarries, and kill sites. Recorded sites are densest along creeks and springs in the foothills below 4,000 feet and in meadows and along ridge flats above 4,000 feet.

Nevada County. Of the 572 sites recorded within Nevada County, 92 are historic sites or have historic components. Approximately 5 percent of the county has been surveyed for cultural resources. The degree of disturbance in the county may be rated as low.

Prehistoric sites include habitation sites, rock shelter sites, milling stations, temporary camps, quarries, cemeteries, and trails. Recorded sites are densest along the Middle Fork Yuba River, along creeks in the foothills, and along creeks and ridge flats in mountainous areas.

Placer County. Of the 783 sites recorded within Placer County, 156 are historic sites or have historic components. Approximately 5 to 10 percent of the county has been surveyed for cultural resources. The degree of disturbance may be rated as moderate overall, with a high level of disturbance in the southwest area of the county, especially along the Interstate 80 corridor.

Prehistoric sites include milling stations, habitation sites, cemeteries, artifact scatters, rock shelter sites, quarries, lithic scatters, temporary camps, ceremonial locations, rock alignments, and petroglyphs. Recorded sites are densest along the Bear River, North and Middle Fork American rivers, Linda Creek, Auburn Ravine Creek, and Dry Creek; near oak groves and exposed bedrock in lower elevations; and along creeks and ridge flats in the higher elevations.

Sacramento County. Of the 435 sites recorded in Sacramento County, 28 are historic sites or have historic components. Approximately 5 to 10 percent of the county has been surveyed for cultural resources. The degree of disturbance in Sacramento County may be rated as high, primarily due to a large metropolitan area, several smaller developments, U.S. Air Force bases, mining, and farming.

Prehistoric sites are dominated by habitation sites but also include milling stations, temporary camps, and rock shelter sites. Recorded sites are densest along the Mokelumne, Cosumnes, American, and Sacramento rivers; along Deer Creek; and within the Delta region (sites mostly destroyed by agricultural and reclamation activities).

Sutter County. Of the 80 sites recorded within Sutter County, 18 are historic sites or have historic components. Approximately 2 percent of the county has been surveyed for cultural resources. The overall degree of disturbance in Sutter County may be rated as low, with Yuba City being the only large area of development.

Prehistoric sites include habitation sites, burials, temporary camp sites, milling stations, and lithic scatters. Recorded sites are densest along the Sacramento, Bear, and Feather rivers.

Yuba County. Within Yuba County, of the 1,202 sites that have been recorded, 90 are historic sites or have historic components. Approximately 15 percent of the county has been surveyed for cultural resources. The overall degree of disturbance in Yuba County may be rated as low to moderate.

Prehistoric sites include milling stations, habitation sites, house pits, artifact and lithic scatters, rock shelter sites, cemeteries, and petroglyphs. Recorded sites are densest along the Yuba River and its tributaries, in the area north of Camp Far West Reservoir, and along creeks and ridge flats in the Sierra Nevada foothills.

Prehistory of the West Side of the Sacramento Valley, Northern Portion. During the long interval between approximately 12,000 years ago and A.D. 1850, the prehistoric societies of northern California underwent a series of slow but significant changes in subsistence and economic orientation, population densities and distribution, and social organization. Although that record is only partially understood, the clear, broad outlines of the sequence have emerged as data from sites and localities throughout the state have been compared and contrasted. Archeological research in the Red Bluff and Redding areas has been synthesized by Jensen and Reed (1980), Raven et al. (1984), Johnson (1984), and others.

Early archeological investigations within Nomlaki and Wintu ethnographic territory, particularly the Redding area and adjacent tracts of the southern Klamath Mountains, gave archeologists a strong impression that human occupation of this area began only relatively recently, perhaps no earlier than approximately A.D. 900-1000. These investigations include surveys and excavations conducted within the basins of present-day Clair Engle and Whiskeytown lakes (Treganza, 1958; 1959; Treganza and Heickson, 1960), the Lake Shasta Basin (Smith and Weymouth, 1952), and the Redding area (Dotta and Hullinger, 1964). The archeological expression most commonly represented at these sites, the Shasta Complex, was correctly believed to typify the remains of the prehistoric Wintu and was first described and named in portions of the north Coast Ranges by Meighan (1955).

Meighan (1955) described two ancient complexes in the North Coast Ranges that preceded the Shasta Complex in that area: the Mendocino and Borax Lake complexes. Meighan and Haynes (1970) later attempted to refine the temporal placement of these early complexes, dating the Mendocino Complex at roughly 5000-1000 B.C., and the Borax Lake Complex from approximately 5000 B.C. to perhaps as early as 12,000 B.C. In a major synthesis of regional prehistory in which he revised Meighan's taxonomic system, Fredrickson (1974) subsequently combined the Mendocino and Borax Lake complexes into several stages of what he termed the "Borax Lake Pattern." Typical of the Borax Lake Pattern are Borax Lake wide-stem projectile points in association with manos and milling stones (i.e., metates).

In 1971, Clewett initiated excavations at Site CA-SHA-475 on the banks of Squaw Creek, approximately 24 miles northeast of Redding along Squaw Creek. The lower strata of this site yielded apparent analogs to Borax Lake Pattern assemblages (Clewett, 1974, 1977; Clewett and Sundahl, 1983). Subsequent discoveries of similar assemblages were reported analogs to Borax Lake Pattern assemblages in high-elevation contexts in the northernmost reaches of the north Coast Ranges (Jackson, 1975) and in the southern Klamath Mountains (Jensen and Farber, 1982). Clewett's finding left no doubt that human culture had attained considerable antiquity at the northernmost end of the Sacramento Valley. Further confirmation of considerable antiquity came from excavations at Site CA-TRI-205 at Helena. Undertaken during the 1980 and 1981 seasons, the Helena work revealed the presence of three distinct prehistoric horizons, including a Shasta Complex terminal occupation preceded by an earlier occupation characterized by a typical Mendocino Complex assemblage and defined by Meighan (1955). Preceding the Mendocino Complex occupation at this site, at a depth of nearly 3 meters beneath the ground surface, was a much earlier complex tentatively named the "Helena Phase" and characterized by a distinctive projectile point type called the Helena corner-notched point.

Based on these and other recent excavations, a tentative reconstruction of a fairly long prehistoric sequence has emerged for the west side of the northern Sacramento Valley. This long sequence was apparently punctuated, if not largely defined, by several cultural introductions that may have coincided with population movements into the region. Specifically, the earliest occupants of this portion of northern California are believed to have been Hokan speakers whose material culture closely resembled the assemblages of the Borax Lake and Mendocino complexes dating to a similar time period. Although population density was probably quite low during this period (circa 4500 B.C. to A.D. 200), these people were widely distributed throughout the region and presumably occupied at least portions of the Sacramento Valley floor and probably used acorns. Large, wide-stemmed projectile points, manos, and milling stones are frequently encountered artifactual types. These early occupants may also have been ancestral to later northern Sierra Nevada, Southern Cascade, Klamath, and Coast Range cultural complexes and perhaps formed part of a continuum into the ethnography present in some areas, such as Southern Cascade foothills (e.g., in the case of the Yana Indians).

Some time by approximately A.D. 200, Penutian-speaking immigrants entered the region and initially disrupted, and eventually began to displace, the Hokan occupants in many areas. It has been hypothesized that the Penutian subsistence pattern and related technology were more suited to the exploitation of a riverine environment and to a more intensive and extensive use of bulbs and other plants. This was coupled with animal and fishing products more intensively processed with mortars and pestles, corner-notched and small-stemmed projectile points more suited for use with bows and arrows, and a variety of other more specialized technological devices. The abundance of fish, clams, bulbs, tules, acorns, and other resources, together with the Penutian penchant for more intensive and extensive exploitation of these items, is believed to have produced a rapid population increase that eventually resulted in the Penutians displacing the Hokan occupants from the Sacramento Valley floor and portions of the adjacent foothills and mountain ranges on both sides of the northern Sacramento Valley. This process was still underway at the time of Euroamerican contact in the mid-19th century.

As the Penutian expansion progressed, considerable pressure was exerted on the neighboring Yana, who eventually withdrew a substantial distance from the eastern edge of the northern Sacramento Valley. The archeological expressions of this late prehistoric time period in Yana territory are represented in the Mill Creek and Dye Creek complexes (Dondero et al., 1982), which is contemporary with the Shasta Complex materials of the Redding area. Sundahl (1982) further distinguishes Tehama Pattern peoples (Yana Indians) from Augustine Pattern peoples (Shasta Complex, ancestors of the ethnographic and historic Wintu Indians).

Prehistoric Resources—West Side of the Sacramento Valley, Northern Portion. Prehistoric resources for the northern Sacramento Valley are discussed in the next section with the prehistoric resources in the southern portion of the valley.

Prehistory of the West Side of the Sacramento Valley, Southern Portion. In the late 1800s and early 1900s, knowledge of lower Sacramento Valley/Delta prehistory was derived largely from local collectors. Collections of J.A. Barr and E.J. Dawson, excavators working in the Stockton area from 1893 to the early 1930s, provided the groundwork for the later development of a three-phase chronological sequence for central California (Ragir, 1972). One

of the first significant archeological reports for this region provided a systematic record of 92 sites and an overview of previous discoveries (Schenck and Dawson, 1929).

Professional archeological research in the lower Sacramento Valley was initiated during the 1920s and 1930s. In 1936, J.B. Lillard and W.K. Purves of Sacramento Junior College identified three "cultural levels" (which they appropriately named "Early," "Intermediate," and "Recent") at several mound sites near the Deer Creek-Cosumnes River confluence in Sacramento County. These levels were based on artifacts and burial orientation and condition. In 1939, a synthesis of this research was published and later expanded into the Central California Taxonomic System (CCTS) (Lillard et al., 1939). Later refined by R.F. Heizer (1949) and R.K. Beardsley (1948, 1954) of the University of California, Berkeley, the CCTS was characterized by specific artifact types, mortuary practices, and other cultural features.

Subsequent archeological research was aimed at refining the CCTS and incorporating the study of paleoenvironmental change, settlement patterns, population movement, subsistence strategies, and the development of exchange networks. These studies led to the establishment of different cultural models for many localities of central California. One such model, developed by Fredrickson (1973) and summarized by Moratto (1984), is based on the concept of cultural "patterns." Rather than widespread synchronic cultural adaptations characteristic of the culture-horizon system, the pattern concept identified "an adaptive mode extending across one or more regions, characterized by particular technological skills and devices, particular economic modes, including participation in trade networks and practices surrounding wealth, and by particular mortuary and ceremonial practices" (Fredrickson, 1973).

Little is known of human occupation in the lower Sacramento Valley prior to 4500 B.P. Because of rapid alluvial and colluvial deposition in the valley over the past 10,000 years, ancient cultural deposits have been deeply buried in many areas. The earliest evidence of widespread occupation of the lower Sacramento Valley/Delta region comes from several sites assigned to the Windmiller Pattern (previously, "Early Horizon"), dated circa 4500-2500 B.P. (Ragir, 1972). Windmiller Patten origins are believed to be linked to the arrival of Utian peoples from outside of California, who were adapted to riverine and wetland environments (Moratto, 1984).

Windmiller settlement patterns and subsistence strategies are poorly known because of the small number of identified sites. Based on available data, however, it seems clear that Windmiller sites are concentrated on low rises or knolls within the floodplains of major creeks or rivers. Such locations provided protection from seasonal flooding and proximity to riverine, marsh, and valley grassland biotic communities. Most known Windmiller sites consist of cemeteries, suggesting a degree of sedentism, in which skeletons are typically extended ventrally, oriented toward the west, and accompanied by abundant grave goods. Subsistence apparently focused on hunting and fishing, as evidenced by large projectile (spear or dart) points, clay net sinkers, bone fish hooks and spears, and abundant faunal remains. Collection and processing of floral resources, such as seeds and nuts, is inferred from mortar and milling slab fragments recovered from a few of the sites. Other characteristic artifacts include charm stones, quartz crystals, bone awls and needles, and abalone (*Haliotis* spp.) and olive snail (*Olivella* spp.) shell beads and ornaments. Trade is reflected in the material from which utilitarian, ornamental, and ceremonial objects were

produced (Beardsley, 1948; Gerow, 1974; Heizer, 1949; Heizer and Fenenga, 1939; Lillard et al., 1939; Ragir, 1972; Schulz, 1970).

The succeeding Berkeley Pattern (formerly the "Middle Horizon") dates from circa 2500 to 1500 B.P. in the Central Valley area, overlapping in time with at least some Windmiller manifestations. Berkeley Pattern sites are greater in number and more widely distributed than Windmiller sites and are characterized by deep midden deposits, suggesting intensified occupation and a broadened subsistence base. The abundance of milling slabs, mortars, and pestles indicates a dietary emphasis on vegetal resources; however, distinct projectile points and faunal remains attest to the continued importance of hunting. Fishing technology improved and diversified, suggesting greater reliance on riverine estuarine resources. Similarities with the Windmiller Pattern include mortars and milling slabs, quartz crystals, charm stones, projectile point styles, shell beads and ornaments, and bone tools. New elements include steatite beads, tubes and ear ornaments, slate pendants, and burial of the dead in flexed positions with variable orientation or cremations accompanied by fewer grave goods. Trade continued to be important. (Beardsley, 1948; Fredrickson, 1973; Heizer and Fenenga, 1939; Lillard et al., 1939; Moratto, 1984.)

The late prehistoric period (ca 1500 to 100 B.P. and formerly referred to as the "Late Horizon" of the lower Sacramento Valley) is characterized by the Augustine Pattern (Fredrickson, 1973). Development of the Augustine Pattern was apparently stimulated by the southward expansion of Wintuan populations into the Sacramento Valley (Moratto, 1984). The Augustine Pattern represents the peak cultural development of the prehistoric period in the lower Sacramento Valley and Delta regions and is characterized by intensified hunting, fishing, and gathering subsistence strategies; large, dense populations; highly developed trade networks; elaborate ceremonial and mortuary practices; and social stratification. In addition to cultural elements from the preceding patterns, adapted new elements include shaped mortars and pestles, bone awls for basketry, bone whistles and stone pipes, clay effigies, and the introduction of the bow and arrow as evidenced by small notched and serrated projectile points. Pottery is also found at a few of the sites assignable to this period. Burials were flexed with variable orientation and generally lacked grave goods (Beardsley, 1948; Fredrickson, 1973; Moratto, 1984; Ragir, 1972).

Prehistoric Resources—West Side of the Sacramento Valley, Southern Portion. This section provides information for prehistoric resources from the northern and southern portions of the west side of the Sacramento River Region.

Colusa County. A total of 199 sites have been recorded within Colusa County. Of these, 84 are historic sites or have historic components. Approximately 2 to 3 percent of the county has been surveyed for cultural resources. The overall degree of disturbance in Colusa County may be rated as low, with few large areas of development.

Types of prehistoric sites include primary habitation sites, temporary camps, lithic and artifact scatters, occasional milling stations where exposed bedrock occurs, quarries, cemeteries, and trails. Recorded sites occur in the highest density along the Sacramento River where large, deep middens have been documented, and along smaller streamcourses entering the Sacramento River

from the west. These streams include Freshwater Creek, Salt Creek, Glenn Valley Slough, Lurline Creek, and ephemeral tributaries of these streamcourses.

Glenn County. Approximately 474 sites have been recorded within Glenn County, 101 of which are historic sites or have historic components. Approximately 1 to 2 percent of the county has been surveyed for cultural resources. The overall degree of disturbance in Glenn County may be rated as low, with few large areas of development.

Types of prehistoric sites include primary habitation sites, temporary camps, lithic and artifact scatters, milling stations, quarries, ceremonial sites and features, petroglyphs, cemeteries, and trails. Recorded sites occur in the highest density along the Sacramento River and its primary tributaries in this area, including Stony Creek and the numerous ephemeral tributaries of the Stony Creek system. A high density of sites is located within the higher elevation zones within the western portion of the county.

Napa County. Of the 860 sites recorded within Napa County, 160 are historic sites or have historic components. Approximately 5 percent of the county has been surveyed for cultural resources. The overall degree of disturbance in Napa County may be rated as moderate.

Types of prehistoric sites include primary habitation sites, temporary camps, lithic and artifact scatters, milling stations, quarries, cemeteries, ceremonial locations and features, rock shelter sites, petroglyphs, trails, and large shell middens within the southern portion of the county where the Napa River enters the upper San Francisco Bay. Recorded sites occur in the highest density along the Napa River and ephemeral tributaries of this stream, and along creek margins and defined ridges in the northern and northwestern portions of the county where mountainous terrain is present.

Shasta County. A total of 2,104 sites have been recorded within Shasta County. Of these, 721 are historic sites or have historic components. Approximately 8 percent of the county has been surveyed for cultural resources. The overall degree of disturbance in Shasta County may be rated as low, with areas of significant disturbance associated with reservoir inundation.

Types of prehistoric sites include primary habitation sites, temporary camps, lithic and artifact scatters, milling stations, quarries, surface rock alignments, cave and rock shelter sites, ceremonial sites and features, petroglyphs, cemeteries, and fishing stations. Recorded sites occur in highest density along the Sacramento River, Cow Creek, and other major streams in western Shasta County, and along Hat Creek, Montgomery Creek, the Pit River, Hatchett Creek, and other major streams in central and eastern Shasta County. Smaller streamcourses, numerous developed ridge systems, and meadow margins at numerous locales within the county contain a high density and wide range of site types.

Solano County. Of approximately 380 sites recorded within Solano County, 80 are historic sites or have historic components. Approximately 5 to 6 percent of the county has been surveyed for cultural resources. The overall degree of disturbance in Solano County may be rated as moderate, with areas of high disturbance (especially along the Interstate 80 corridor, where development is most rapid).

Types of prehistoric sites include primary habitation sites (including large shell middens along the margins of Suisun Bay and other Delta and Bay settings within the southern portion of the county), temporary camps, lithic and artifact scatters, cemeteries, trails, and ceremonial sites and features. Recorded sites occur in the highest density along the Sacramento River, Suisun Creek, Ulatis Creek, and Putah Creek, and along the margins of Suisun Bay.

Tehama County. Of 1,615 sites recorded within Tehama County, 200 are historic sites or have historic components. Approximately 2 percent of the county has been surveyed for cultural resources. The overall degree of disturbance in Tehama County may be rated as low, with few large centers of development.

Types of prehistoric sites include primary habitation sites, temporary camps, lithic and artifact scatters, milling stations, quarries, rock shelters, ceremonial sites and features, possible celestial alignments, petroglyphs, cemeteries, fishing stations along the Sacramento River, and trails. Recorded sites occur in the highest density along the Sacramento River, Cottonwood Creek, and other major streams in western Tehama County, and along Dye, Deer, and Mill creeks in eastern Tehama County. The smaller streamcourses and numerous developed ridge systems throughout the county contain a high density and wide variety of prehistoric sites.

Yolo County. Of 181 sites recorded within Yolo County, 6 are historic sites or have historic components. Approximately 2 to 3 percent of the county has been surveyed for cultural resources. The overall degree of disturbance in Yolo County may be rated as low to moderate.

Prehistoric site types include primary habitation sites, temporary camps, lithic scatters, occasional milling stations where exposed bedrock occurs, cemeteries, petroglyphs, and possible fishing stations along Putah and Cache creeks, the Sacramento River, and along ephemeral tributaries of these streams. A relatively high density of sites occurs along creek margins and defined ridges in the mountainous western portion of the county.

History of the East Side of the Sacramento River Region. The east side of the Sacramento Valley is characterized by agricultural settlement and mining. Agricultural activities in the east side Sacramento River Region are based on the establishment and development of commercial crops, accessibility to markets, new farming techniques, and irrigation. Mining activities in the southern portion of the east side of the region (El Dorado, Nevada, and Placer counties) are related to the discovery of gold at Sutter's Mill and the subsequent gold rush. The economy of the east side has been based on mining, agriculture, and government services since the late 1800s. Historic resources are related to the settlement of the subregion and include mining features, homesteads, economic/industrial facilities, residential properties, commercial establishments, and government facilities.

Historic-Period Resources—East Side of the Sacramento River Region. Table II-1 shows the number of resources listed in the NRHP, California Historical Landmarks, California Inventory of Historic Resources, and California Points of Historical Interest by county in the Sacramento River Region. The resources described in the following section include only those resources listed in these sources.

TABLE II-1

NUMBER OF HISTORIC RESOURCES IN THE SACRAMENTO RIVER REGION

County	Number of Properties in the National Register of Historic Places	Number of California Historic Landmarks	Number of Sites in California Inventory of Historic Resources	Number of California Points of Historical Interest
Amador	15	23	43	5
Butte	24	9	31	19
Colusa	5	3	6	3
El Dorado	16	29	40	8
Glenn	2	2	17	17
Napa	57	17	31	11
Nevada	19	18	46	35
Placer	13	20	27	18
Sacramento	69	56	43	16
Shasta	22	19	41	15
Solano	18	14	30	7
Sutter	0	2	22	21
Tehama	8	4	13	1
Yolo	18	2	37	8
Yuba	8	6	25	12

Amador County. Historic resource themes found in Amador County include aboriginal, architecture, economic/industrial, exploration/settlement, religion, and social/education. The NRHP lists 15 properties, 23 properties are California Historical Landmarks, and 5 properties are considered California Points of Historical Interest. No Reclamation facilities are located in Amador County.

Butte County. Historic resource themes found in Butte County include aboriginal, architecture, economic/industrial, exploration/settlement, government, religion, and social/education. The NRHP lists 24 properties, 9 properties are California Historical Landmarks, and 19 properties are considered California Points of Historical Interest. No Reclamation facilities are located in Butte County.

El Dorado County. Historic resource themes found in El Dorado County include architecture, economic/industrial, exploration/settlement, government, religion, and social/education. The NRHP lists 16 properties, 29 properties are California Historical Landmarks, and 8 are considered California Points of Historical Interest. Numerous historic sites, such as mining features, building foundations, trash scatters, and bridges, were inundated by Folsom

Lake, which is a Reclamation facility. No historic/architectural resources are found in the vicinity of Sly Park Dam, which is the other Reclamation facility in El Dorado County.

Nevada County. Historic resource themes found in Nevada County include aboriginal, architecture, arts/leisure, economic/industrial, exploration/settlement, government, religion, and social/education. Nineteen properties are listed in the NRHP, 18 are California Historical Landmarks, and 35 properties are considered California Points of Historical Interest. No Reclamation facilities exist within Nevada County.

Placer County. Historic resource themes found in Placer County include aboriginal, arts/leisure, economic/industrial, exploration/settlement, and social/education. Thirteen properties are listed in the NRHP, 20 are California Historical Landmarks, and 18 are considered California Points of Historical Interest. Numerous historic sites, such as mining features, building foundations, trash scatters, and bridges, were inundated by both Sugar Pine Reservoir and Folsom Lake, which are Reclamation facilities.

Sacramento County. Historic resource themes found in Sacramento County include aboriginal, architecture, arts/leisure, economic/industrial, exploration/settlement, government, military, religion, and social/education. The NRHP lists 69 properties, 56 properties are California Historical Landmarks, and 16 properties are considered California Points of Historical Interest. Numerous historic sites, such as mining features, building foundations, trash scatters, and bridges, were inundated by Folsom Lake, which is a Reclamation facility in Sacramento County. In addition, the Folsom Mining District surrounds Lake Natoma, another Reclamation facility.

Sutter County. Historic resource themes found in Sutter County include architecture, economic/industrial, exploration/settlement, government, religion, and social/education. No properties are listed in the NRHP, 2 properties are California Historical Landmarks, and 21 properties are considered California Points of Historical Interest. No Reclamation facilities are located in Sutter County.

Yuba County. Historic resource themes found in Yuba County include architecture, economic/industrial, exploration/settlement, religion, and social/education. The NRHP lists 8 properties, 6 are California Historical Landmarks, and 12 are considered California Points of Historical Interest. No Reclamation facilities are located in Yuba County.

CVP Facilities. No CVP facilities in this geographic subregion are considered historic resources.

History of the West Side of the Sacramento River Region. The west side of the Sacramento River Region is characterized by agricultural settlement based on the establishment and development of commercial crops, accessibility to markets, new farming techniques, and irrigation. The economy of the west side of the region has been agriculturally based since the late 1800s. Historic resources are related to the settlement of the west side and include homesteads, economic/industrial facilities, residential properties, commercial establishments, and government facilities.

Historic-Period Resources—West Side of the Sacramento River Region. Table II-1 shows the number of resources listed in the NRHP, California Historical Landmarks, California Inventory of Historic Resources, and California Points of Historical Interest by county in the Sacramento River Region. The resources described in the following section include only those listed in these sources.

Colusa County. Historic resource themes found in Colusa County include aboriginal, architecture, economic/industrial, exploration/settlement, government, and religion. The NRHP lists five properties, three are California Historical Landmarks, and three are considered California Points of Historical Interest. No historic/architectural resources are found in the vicinity of the Tehama-Colusa Canal, which is the only Reclamation facility within Colusa County.

Glenn County. In Glenn County, historic resource themes include economic/industrial, exploration/settlement, and government. The NRHP lists 2 properties, 2 are California Historical Landmarks, and 17 are considered California Points of Historical Interest. No historic/ architectural resources are found in the vicinity of the Tehama-Colusa Canal, which is the only Reclamation facility within Glenn County.

Napa County. Architecture, arts/leisure, economic/industrial, exploration/settlement, military, religion, and social/education are the primary historic resource themes found in Napa County. The NRHP lists 57 properties, 17 are California Historical Landmarks, and 11 are considered California Points of Historical Interest. No CVP facilities are located solely within Napa County, although the Solano Project is located within both Napa and Solano Counties.

Shasta County. Historic resource themes found in Shasta County include aboriginal, architecture, economic/industrial, exploration/settlement, military, religion, and social/ education. Twenty-two properties are listed in the NRHP, 19 properties are California Historical Landmarks, and 15 properties are considered California Points of Historical Interest. Shasta and Keswick Dams, both of which are Reclamation facilities determined eligible for listing in the NRHP, are located in Shasta County. The Shasta Lake pool area is known to contain numerous historic sites, some of which may be eligible for listing in the NRHP. The town of Kennett was inundated when Shasta Lake was formed. No historic/architectural resources are found in the vicinity of the other Reclamation facilities in Shasta County.

Solano County. Historic resource themes found in Solano County include architecture, economic/industrial, exploration/settlement, government, military, religion, and social/education. Eighteen properties are listed in the NRHP, 14 are California Historical Landmarks, and 7 properties are considered California Points of Historical Interest. No CVP facilities are located in Solano County.

Tehama County. Historic resource themes found in Tehama County include architecture, economic/industrial, exploration/settlement, government, military, religion, and social/education. Eight properties are listed in the NRHP, four properties are California Historical Landmarks, and one property is considered a California Point of Historical Interest. No

historic/ architectural resources are known in the vicinity of the Tehama-Colusa Canal, Corning Canal, or RBDD, which are the Reclamation facilities within Tehama County.

Yolo County. In Yolo County, historic resource themes include architecture, arts/leisure, economic/industrial, exploration/settlement, government, religion, and social/education. Eighteen properties are listed in the NRHP, two properties are California Historical Landmarks, and eight properties are considered California Points of Historical Interest. No historic/architectural resources are known in the vicinity of the Tehama-Colusa Canal, which is the only Reclamation facility within Yolo County.

CVP Facilities. Shasta and Keswick dams have been determined eligible for listing in the NRHP. They are considered key structures of the CVP. Shasta Dam is one of the larger concrete gravity dams ever constructed, is considered important for its engineering qualities, and is associated with the comprehensive water distribution system of the CVP. The eligible property includes Shasta Dam as a contributing structure and the powerplant as a contributing building. The period of significance is 1938, the year construction began on Shasta Dam. Keswick Dam and its powerplant have also been determined eligible for listing in the NRHP.

Ethnography of the East Side of the Sacramento Valley.

Maidu, Konkow, and Nisenan. Maidu (also known as northeastern Maidu), Konkow (also known as northwestern Maidu), and Nisenan (also known as southern Maidu) inhabited an area of California from Lassen Peak to the Cosumnes River, and from the Sacramento River to Honey Lake. The division of these three groups is based on language differences and geographic location. The language of each group has been classified as a separate language within the Maiduan family, Penutian stock (Shipley, 1978). Several subdivisions of language (i.e., dialects) existed within each group.

Northeastern Maidu territory encompassed the area from Lassen Peak on the northwest to Honey Lake on the east, to the Sierra Buttes on the south, to Eagle Lake on the north. The Konkow inhabited the region from the Lower Feather River, south to about the Sutter Buttes, and west just beyond the Sacramento River. The Nisenan lived in the area east of the Sacramento River, almost to Lake Tahoe on the east, north to about the Middle Fork Feather River, and south to about the Cosumnes River (Riddell, 1978; Wilson and Towne, 1978a and 1978b).

The subsistence strategy of the Maidu was based on seasonally mobile hunting and gathering. Acorns, the primary staple, were gathered in the valley along with seeds, buckeye, salmon, insects, and a wide variety of other plants and animals. During warmer months, people moved to mountainous areas to hunt and collect food resources found in higher elevations, such as pine nuts. Because the Maidu territory was largely a mountainous one, they relied more heavily on hunting than did the other groups.

Politically, the Maidu were organized around the tribelet. Each tribelet was composed of several villages, and when needed for group decisions or group activities, the headman of one of the villages in a tribelet was selected to be the leader. Headmen were not powerful, but acted as advisors and, among the Maidu and Konkow, were chosen through the auspices of a shaman for

qualities such as wealth, maturity, ability, and generosity. Among the Nisenan, the headman position was hereditary.

The histories of the Maidu closely parallel one another following Euroamerican contact in 1808. After the first contact, extensive exposure to whites occurred between 1828 and 1836, with intensive fur trapping in the region by Hudson's Bay Company. In 1833, a malaria epidemic killed up to 75 percent of the Maidu population. Sutter's Fort, established in Nisenan territory in 1839, became the focal point of settlers and miners' incursions into Maidu and Konkow areas (especially after the 1848 discovery of gold). The population reduction from the epidemic left the Maidu, Konkow, and Nisenan unable to resist the overwhelming flood of miners and settlers. Many of the few survivors became wage laborers on mines and ranches, and their language and culture diminished.

Yana. The Yana of north-central California inhabited an area from Lassen Peak and the southern Cascade foothills on the east, Rock Creek on the south, Pit River on the north, and the east bank of the Sacramento River on the west. The west boundary is most uncertain, however, and may have been quite changeable because of poor relations with the Wintun to the west (J. Johnson, 1978).

Linguistically, the Yana were composed of four subdivisions: northern, central, southern Yana, and Yahi. The Yana language is classified within the Yana Family (Yana and Yahi are the only members) of the Hokan stock. The Yana were hunter-gatherers who relied heavily on the acorn crop, their primary food source. Other important food resources included deer, bear, antelope, elk, salmon, rabbits, quail, insects, rodents, river mussels, various roots, tubers, bulbs, seeds, buckeyes, pine nuts, and berries.

The principal political organization was that of the tribelet, a large village with several allied smaller villages. Each tribelet had a chief or headman who inherited his position. The chief's power was confined to prestige, advice, and suggestion. He did not have the power to impose his will on the other members of the tribelet. There was no political structure beyond the tribelet, although alliances, trading, and intermarriage occurred.

Like most Native American groups in California, the Yana manufactured a wide range of implements from bone, antler, wood, and stone. Obsidian, the preferred material for projectile points, was an item of trade by groups to the north. Baskets were made, but they were apparently of relatively poor quality.

Also similar to customs of many California Native American groups was their use of shamans and their approach to illness. If the shaman was unsuccessful, he might be accused of black magic and even be killed.

The first contact of the Yana with whites may have occurred as early as 1821, when a mission-military expedition entered their territory. Between 1828 and 1846, several fur trapping parties crossed through this area and probably had some contact with the Yana. The first permanent Euroamerican settlement in Yana territory was established in 1845. Thereafter, several Mexican land grants were given in this region. By 1848, the California-Oregon Trail

crossed through Yana land. Overall, mining and settlement had little effect on the Yana. However, in 1846, Captain Fremont attacked and killed several Yana. The ensuing years brought several massacres, which resulted in the nearly total elimination of the Yana-Yahi people. Ishi, the last Yahi, vacated his territory and came to live at the University of California, Berkeley, in 1911 and died in San Francisco in 1916.

Ethnography of the West Side of the Sacramento Valley.

Wintu and Nomlaki. At the time of Euroamerican contact, most of the western side of the Sacramento Valley north of about Suisun Bay was inhabited by Wintun-speaking people. Powers (1877) had recognized early linguistic and cultural distinctions between the southern membership of this large group (i.e., the Patwin) and the peoples occupying the northern half of the western valley. Subsequent linguistic analyses resulted in the present division of Wintuan into a southern Patwin group, a Central (Nomlaki) group, and a northern (Wintu) Wintuan stock. Clearly, however, the central and northern Wintuans were very closely related to one another and shared numerous cultural traits and attributes. For this technical appendix, these two groups are summarized in this single subsection.

Two major divisions existed among the Nomlaki: the River and Hill Nomlaki. The River Nomlaki occupied the Sacramento River Valley, primarily in present eastern Tehama County. The Hill Nomlaki occupied adjacent foothill lands to the west, extending to the summit of the Coast Ranges in what is now Tehama and Glenn counties.

The Wintu, on the other hand, were divided into nine subareas or subgroups (Du Bois, 1935), distributed from Cottonwood Creek in the south, northward through Shasta and into portions of Trinity and Siskiyou counties, and westward into portions of southern Trinity and northern Tehama counties.

For the Wintu and Nomlaki, subsistence was based on three main staples: deer, acorns, and salmon. All three were abundant within the western Sacramento Valley, particularly along the Sacramento River and its primary tributaries, although the latter two were available only seasonally. These staples were supplemented with an immense array of less abundant resources, some seasonally available and some procurable year-round.

Salmon was so crucial as a food resource to the River Nomlaki and the Wintu that the availability of this food source has been used as an important variable in assessing prehistoric population levels (Baumhoff, 1963) and is considered a major determinant of site distribution within portions of the Redding area (Raven et al., 1984). Other important riverine resources included trout, lamprey, whitefish, suckers, mussels, and clams. Fish poisons were used in some of the small streams and in still pools in securing various aquatic resources (La Pena, 1978), many of which were then dried and stored for winter use (Du Bois, 1935). Although certain fishing places seemed to have been under individual ownership, several mechanisms ensured substantial redistribution of abundant harvests, including reciprocal exchange obligations, trade, and community fish drives to which other Wintu villages or subgroups were frequently invited (Du Bois, 1935; La Pena, 1978).

Deer constituted a major dietary staple, a food source that was both abundant and available essentially year-round. Deer were often hunted individually with bow and arrow, but also communally by being driven into snares, into ambuscades, or over cliffs (Du Bois, 1935). Many other animals were hunted with bows or slings, snared, clubbed, or shot in communal drives, including bear, rabbit, quail and other birds, rodents, and certain reptiles (Goldschmidt, 1978; Du Bois, 1935).

Acorns constituted the third primary staple of the Nomlaki and Wintu, a food resource that was seasonally abundant as well as storable. Prepared during late prehistoric time periods with a hopper mortar and pestle into a meal for soup or a flour for bread, acorns were available for immediate consumption or for winter storage. Black and valley oak acorns were preferred for breads. Buckeye, which, like acorns, had to be leached, was an important vegetal resource, and other vegetal foods, including herbs, nuts, berries, fruits, seeds, and roots, were consumed in large quantities in early spring and summer (Goldschmidt, 1978; Du Bois, 1935).

The available ethnographic information documents a pattern of land use, settlement, and subsistence orientation that was quite complex. The salmon runs, the locations of seasonally available big game (especially deer), and the distribution of acorn-yielding oak trees, which together supplied the primary staples for these Native Americans, required major forays from the home base because all three were concentrated in different areas. Moreover, the collection of exotic raw materials, such as obsidian and certain other utilitarian materials, often involved long and arduous trips. Because the locations and availability of these resources could not be modified by the Native Americans, it was necessary for both the Nomlaki and Wintu to arrive at a particular resource during its peak of production and ease of attainment. By appropriately arranging their patterns of movement, these Native American peoples were able not only to ensure an adequate supply of the primary staples in most years, but also to supplement these staples by hunting and collecting virtually every type of animal and plant food available within their territorial range. In addition to serving dietary needs, many of the collected animals, hundreds of varieties of plants, and inorganic minerals were also sought for medicinal, technical, and magico-religious purposes. This form of resource exploitation required not only that permanent villages be established, but that seasonal use be made of a wide variety of less permanent villages and camps (Goldschmidt, 1978).

Although the nuclear family was the basic, face-to-face interaction group of the Nomlaki and the Wintu, the social culture of both groups was centered on the village, or tribelet, as originally described by Kroeber (1932b). Village authority was vested in a headman whose succession was inherited patrilineally, subject to approval by other male elders. Perpetuation of this role was particularly dependent on the ability of the individual to maintain social preeminence through organizational talents and the accumulation of wealth. The primary duties of a chief or headman were to lead rather than to rule, and included giving advice, settling disputes, and redistributing food resources, the latter being of particular significance in terms of maintaining stable and equal food supplies throughout the village over long periods of time. In sum, the economic cooperation effected through the chief's office served as the focal point for the social and political organization of the clusters of nuclear families, which in turn constituted a village or tribelet.

According to Goldschmidt (1978) and Du Bois (1935), the external relationships of both the Nomlaki and Wintu were far-reaching. The Chimariko obtained knives and arrowheads through trade with the Wintu, and money (e.g., Dentalium, beads, and shells) came to the Wintu from the Pomo Indians to the west (Dixon, 1910). Most of the Wintu obsidian was obtained directly through excursions to the Medicine Lake highlands, although some additional material was obtained from the Shasta Indians in exchange for deer hides and woodpecker scalps (Du Bois, 1935). The Nomlaki traded salt and food surpluses to the Wintu and the Shasta for skins, obsidian, and yew wood for bows. Some Nomlaki individuals apparently specialized in trade, although as Goldschmidt (1978) points out, this profession was potentially very dangerous. Frequently, such specialists used the clamshell beads that had become a medium of exchange and standard of value throughout much of Central California, although direct barter was also used when appropriate.

The assimilation of Nomlaki and Wintu culture has been well documented in the literature. For the Wintu, the major factors have been analyzed by Greenwood and Shoup (1983). Their earliest contacts with Euroamericans were probably with hunters, trappers, and explorers who sporadically entered and crossed the northern Sacramento Valley during the 1820s and 1830s. A malaria epidemic in 1833 killed an estimated 75 percent of the Sacramento Valley Indians. Many Nomlaki and Wintu villages were completely depopulated at this time (Cook, 1955). The Sacramento Valley Indians never overcame the devastating effects of this epidemic and were ineffective in their efforts to resist the onslaught of miners and settlers into this region from the early 1850s through the 1880s. Following the arrival of miners and settlers, the Nomlaki and Wintu suffered further catastrophic reductions in population, followed by the collapse in the economic and social bases for perpetuation of their traditional lifestyle. Eventually, the surviving members were moved to coastal and other reservations and camps. By the 1930s, there were three Nomlaki rancherias of six households each, with the men serving primarily as casual or migratory laborers (Goldschmidt, 1978).

Patwin. The Patwin held an extensive region within north-central California, involving the lower portion of the west side of the Sacramento Valley, west of the Sacramento River, from the town of Princeton in the north to Benicia in the south (Kroeber, 1925). The Patwin were bounded to the north, northeast, and east by other Penutian-speaking peoples (the Nomlaki, Wintu, and Maidu, respectively) and to the west by the Pomo and other coastal groups. Within this large territory, the Patwin have traditionally been divided into River, Hill, and Southern Patwin groups, although, in actuality, a more complex set of dialects and cultural differences existed than is indicated by these three primary geographic divisions.

Despite the expansive territorial range of the Patwin, relatively little ethnographic information is available for this once populous group. Powers, whose travels through California in 1871-1872 generated the first systematic record of the languages, territories, and cultures of many of the state's Native American groups, found few informants still living in traditional Patwin territory (Powers, 1976). Kroeber later observed that "...from Knight's Landing downstream usable data are almost nil, the Indians having disappeared...and the southern half of the Patwin group has thus become wholly extinct..." (Kroeber, 1925). As a result, information that does exist for Southern Patwin groups has been extrapolated largely from Patwin peoples to the north

(McKern, 1922, 1923; Kroeber, 1932a; Merriam, 1955, 1966) as well as from other neighboring groups (Barrett, 1908; Bennyhoff, 1977).

The Patwin are linked linguistically and culturally with a larger group that appears to represent relatively late arrivals into California. This larger group is the Wintun-speaking people who occupied the entire west side of the Sacramento Valley northward as far as the headwaters of the Sacramento River. The Wintun language family contains three members: the closely related Wintu and Wintun (Nomlaki) to the north and the more distant Patwin to the south. Linguistic analysis of these genetic relationships reveals that the internal divergence between Wintu/Wintuan and Patwin is likely to have occurred approximately 2000 to 2500 B.P., at a time when a single, linguistically less differentiated group inhabited portions of southern Oregon. Subsequent to this time period, these Penutian-speaking peoples apparently migrated south along the Sacramento River into northern California, with the Patwin members reaching the Carquinez/ Suisun area by about 1500 B.P. (Whistler, 1977; McCarthy, 1985a).

As with most of the hunting-gathering groups of California, the tribelet represented the basic social and political unit. Primary tribelet settlements within valley settings tended to be located on high ground, along the Sacramento River or tributary streams, such as Cache, Putah, and Ulatis creeks, and in the numerous valleys nestled along the eastern margin of the Coast Range. Several major settlements, such as the ethnographically recorded villages of Aguasto and Suisun, were located near the marshy environment associated with San Pablo and Suisun bays. The extensive plains areas to the north and northeast, however, seem to have been used primarily for temporary camps, in part because there was little available firewood and because, during spring and summer, these areas were insect-infested and contained only small quantities of easily recovered food (Powers, 1976; P. Johnson, 1978).

Several of the major settlement areas, particularly those near the rich Sacramento River and San Francisco Bay resources, were very populous, some containing as many as 1,000 or more persons (Powers, 1976). However, temporary settlements and camps tended to vary considerably in size, depending primarily on the nature of the foraging or processing tasks being undertaken. Generally, the Patwin settlement system involved sequential occupation of a number of habitat types and construction of a variety of residential structures, ranging from small camps containing only temporary brush shelters, to large, permanently occupied villages containing numerous more substantial circular pit houses.

Typically, a tribelet chief would reside in a major village where ceremonial events also were typically held. The status of such individuals was inherited patrilineally among the Patwin, although village elders had considerable power in determining who actually succeeded to particular positions. The chief's main responsibilities involved administration of ceremonial and economic activities. Such individuals often decided when and where various fishing, hunting, or gathering expeditions would occur and similarly made the critical decisions concerning the more elaborate ceremonial activities. He also played a central role in resolving conflicts within the community or during wars, which occasionally broke out with neighboring groups. Apparently, a Patwin chief had more authority than his counterparts among many of the other central California groups (McKern, 1922; Kroeber, 1925, 1932a; P. Johnson, 1978).

The Southern Patwin were situated in an exceptionally rich environment consisting of bays, marshes, and plains that provided them with three primary resource categories: an abundant fishery; a wide variety of plant foods; and an abundance of game, including tule elk, antelope, and waterfowl. The seasonal availability of these various food resources determined the gathering schedule for the Patwin, much like that of the Costanoan groups. Although fishing was often an individual activity, during the seasonal salmon runs, fishing was frequently communal and involved the use of weirs, nets, and tule boats. Waterfowl were captured with large nets in the marshy areas during winter when the tules provided a habitat for migratory birds.

Hunting and fishing were the responsibilities of the community's males, who also produced the associated tool assemblage, including nets, boats, bows, and arrows. Women's tools consisted primarily of milling equipment and a variety of baskets of many sizes and shapes, which were manufactured from available materials, such as sedge roots and willow and redbud shoots.

Many items that could not be obtained locally were procured through an active and extensive trade network. Clamshell disk beads served as currency in the region, and the Patwin routinely imported pine nuts, seeds, bear hides, beads, and sinew-backed bows from the central Wintun and shell beads, magnesite, salt, clams, and obsidian from the Pomo. In exchange, they exported salmon, river otter pelts, cordage, shell beads, bird feather headbands, and sinew-backed bows to the Pomo (Davis, 1974). In some instances, they acted as middlemen for particular items in the east-west or north-south movement of various commodities.

The growth of missions within California had significant long-term impacts on the Patwin. The Southern Patwin resided in villages located north of San Francisco Bay and provided Mission Delores, Mission San Jose, and later, Mission Sonoma with potential neophytes. Residents from the village of Aguastos were taken to Mission Delores as early as 1800. Once at the missions, introduced diseases, such as measles and smallpox, were instrumental in reducing the Indian population to the point that established cultural traditions and settlement systems could no longer be maintained (Cook, 1943; P. Johnson, 1978; Bennyhoff, 1977; McCarthy, 1984). The onslaught of Euroamericans during the late 1840s, coupled with the gold rush beginning in 1849, decided the fate of the Patwin culture. By 1871-1872, when Stephen Powers surveyed the state while gathering ethnographic information, the Patwin culture no longer existed.

Wappo. The name "Wappo" is an Anglicized derivation of the Spanish word *guapo*, which has a number of meanings, including handsome or brave (Kroeber, 1925; McClellan, 1953). The term was apparently applied to the Wappo by the early Spanish residents of California, who respected the tenacious manner in which this relatively small Native American group defended its homeland against the incursions of the European newcomers (Greengo and Shutler, 1953).

The Wappo occupied two geographical areas involving the extreme western portion of the Sacramento Valley. The largest of the two groups claimed territory that extended from around the present-day city of Napa north to the vicinity of Middletown and Geyserville (Sawyer, 1978; McClellan, 1953). The second Wappo group occupied a smaller territory situated along the southern shore of Clear Lake. Gifford (1923) observed that the latter Wappo grouping may

represent a seasonal occupation only, although linguistic and other evidence argues more convincingly for permanent utilization of this area (Sawyer, 1978).

At the time of initial Euroamerican contact, the Wappo were surrounded by more numerous Native American peoples linguistically unrelated to the Wappo. Wappo language itself is Yukian in derivation, with the closest linguistically affiliated group being the Yuki, whose territory stretched along the northern California coast, immediately north and east of present-day Fort Bragg (Miller, 1978). Bordering the Wappo to the east, northeast, south, and west were Penutian-speaking peoples including the Patwin, the Lake Miwok, and the Coast Miwok (P. Johnson, 1978; Callaghan, 1978; Kroeber, 1925). To the north and west were the Hokan-speaking Pomo (Bean and Theodoratus, 1978; Kroeber, 1925; McLendon and Lowy, 1978; McLendon and Oswalt, 1978). Although the absolute boundaries of Wappo territory cannot be fixed through existing ethnographic data, it is possible that ongoing and future archeological work in the area may supply information on stylistic attributes and/or the presence and absence of certain technological traits with demonstrable cultural affiliations. In this way, changes in territorial boundaries may be traceable through time, and revised hypotheses may be developed concerning large-scale group movements and patterns of migration within this portion of northern California.

Relatively little is known about traditional Wappo society (Kroeber, 1925; Sawyer, 1978); although the group is believed to have numbered between about 500 and 1,650 individuals at the beginning of the final quarter of the 18th century) (Cook, 1943; Kroeber, 1925). Like most native Californians, however, the Wappo clearly obtained their subsistence primarily from hunting and foraging, exploiting much of the potential floral and faunal resources within their territorial range. The acorn represented a staple of the Wappo diet, although these peoples were noted for their fishing expeditions to Clear Lake (Sawyer, 1978), as well as their journeys to the Pacific coast, where both fish and shellfish were exploited (Driver, 1936; Radin, 1924). As with other California Native American groups, a variety of terrestrial mammals were also hunted or snared, particularly deer.

Like many other native Californian groups, the Wappo were divided into numerous small, largely autonomous political groups, traditionally referred to in the literature as tribelets (Kroeber, 1932a). Tribelets were often distinguished from one another by variations in language and cultural practices. During winter, the Wappo tended to congregate into relatively large settlements, often located in the Napa Valley. As many as 100 people might occupy one of these winter settlements (Driver, 1936). Smaller encampments, usually consisting of one or more extended families and scattered throughout Wappo territory, were occupied during portions of spring, summer, and fall (McClellan, 1953).

Although apparently limited, trading relations were maintained between the Wappo and their neighbors. Driver (1936) notes that clams and abalone shells were imported from the Coast Miwok; the Pomo provided tule mats, magnesite beads and cylinders, sinew-backed bows, and fish. Bows were also obtained from the Patwin. In exchange, the Wappo typically traded salt and excess production of various staples (Davis, 1961). The Napa Glass Mountain obsidian quarry, located within Wappo territory, also likely served as a valuable trade resource. Although

limited in intensity, relations between neighboring groups were not always friendly, and feuds between the Wappo and neighboring groups have been documented (Menefee, 1873).

Achumawi, Atsugewi, and Shasta. The Achumawi and Atsugewi of northeastern California are two linguistically and culturally distinct but related groups. The Achumawi and Atsugewi languages belong to the Palaihnihan family, or Hokan stock. Each language is composed of several dialects with varying degrees of mutual intelligibility. Although Achumawi and Atsugewi were not mutually intelligible languages, Atsugewi people frequently learned to speak Achumawi.

A general description of the Achumawi is found in Kroeber (1925), and a comprehensive summary of their culture and history is found in Olmsted and Stewart (1978). The culture and history of the Atsugewi are summarized by Garth (1978).

The territory of the Achumawi extended roughly as far south as Mount Lassen, west to Mount Shasta, northeast to Goose Lake, and east to the Warner Range. Overlapping this area to some extent, the Atsugewi territory ranged from Mount Lassen in the southwest, the Pit River in the north, and Horse Lake to the east.

The Atsugewi and Achumawi recognized themselves as belonging to a particular cultural group distinct from each other and other tribes but did not form politically cohesive groups. The political organization did not extend beyond the tribelet. Intermarriage could occur between villages and between the Atsugewi and Achumawi.

Although culturally the two groups shared many traits, the Atsugewi stressed some typically northwestern California culture traits. Chief among these is the "wealth concept," which emphasized hard work and the accumulation of wealth items, most commonly beads.

The natural environment of both groups is quite varied and includes a wide range of food resources. Staples included acorns, fish, and deer. Also consumed were various seeds, berries, insects, waterfowl, eggs, and bulbs. Many plants were also used as tools and medicines.

The Atsugewi probably first came into contact with Euroamericans in 1827-1828. Several fur trapping expeditions in the 1830s crossed through Atsugewi territory, and by the 1850s, prospectors and settlers had moved into the area. Fighting between settlers and the Atsugewi in the late 1850s resulted in many deaths, and most of the surviving Atsugewi were transported to the Round Valley Reservation. Eventually many returned to their homeland, but few survived. The Achumawi, although greatly diminished in number, continued many of their traditional ways into the 20th century.

The Shasta peoples were originally thought to be associated with the Achumawi and Atsugewi but are now considered separate from them (Kroeber, 1925). The Shasta peoples inhabited the area from southern Oregon at the Rogue River, south to around the headwaters of the New River near Cecilville, California, and roughly in the area between the Marble and Salmon mountains in the west to Mount Shasta and the Cascade Range in the east. In California, the core areas of

settlement were in Shasta Valley, Scotts Valley, and along the Klamath River from about Scotts River to the town of Hornbrook (Silver, 1978b).

The Shasta peoples are composed of four linguistically related groups with largely unknown cultural and historical ties. Their languages have been classified within the Shastan family, or Hokan stock (Shipley, 1978).

The primary subsistence staples of the Shasta were deer and acorns. Other important food sources included bear, small mammals, fowl, salmon, trout and other fish, turtles, river mussels, insects, nuts, seeds, bulbs, roots, and berries. Land was purposely burned to enhance the seed crop, and tobacco was grown and harvested. Fish were obtained with the use of nets, basket traps, weirs, hook and line, and spears. Divers also procured river mussels.

In the 1820s and 1830s, the Shasta peoples first came into contact with Euroamericans who were working as fur trappers in that region. In the 1850s, their population was greatly diminished by the Rogue River Indian wars and by hostilities from miners and settlers. By the 20th century, the Shastan language was virtually extinct, and little of the aboriginal culture remained.

San Joaquin River Region

The San Joaquin River Region includes Fresno, Mariposa, San Joaquin, and Stanislaus counties, and parts of and Calaveras, Merced, Madera, and Tuolumne counties. For the prehistory section that follows, the San Joaquin Valley has been divided by the San Joaquin River and Fresno Slough into east and west sides. The "Prehistoric Resources" and "Ethnographic Overview" sections combine information for the east and west sides into one discussion.

Prehistory of the East Side of the San Joaquin River Region. The cultural chronology and archeological complexes differ in various areas of the San Joaquin River Region but may be generally characterized from data obtained as a result of several large reservoir projects. These projects included the Buchanan Reservoir project undertaken by San Francisco State University; the Hensley Lake project conducted by CSU, Long Beach; and the Lake Kaweah project undertaken by several researchers, including Franklin Fenenga, Clement Meighan, and Jay Von Werlhof, among others, working for a variety of institutions.

Evidence of prehistoric occupation of the Sierra Nevada foothills in this area goes back to 9,500 years. Two sites demonstrate occupations that span most of the Holocene. The vast majority of discovered sites, however, are less than 500 years old, probably representing a relatively recent proliferation of settlements by Yokut Indians (Moratto, 1984). The high Sierra Nevada mountain area is typified by seasonal camps characterized by lithic scatters and few bedrock mortars. The valley/foothill transition zone more often includes sites with midden deposits, structural remains, and numerous bedrock mortars.

Although dated, the chronological sequence developed in the south-central Sierra Nevada as a result of the Buchanan Reservoir project in Madera County is still used as a general framework. The earliest component of the sequence, called the Chowchilla Phase, dates from 800 B.C. to A.D. 550 and is characterized by fish spears, large projectile points, milling stones, various shell

beads and ornaments, atlatl darts, and extended and semi-extended burials with large quantities of grave goods.

The Raymond Phase, A.D. 300 to 1500, is characterized by milling stones, core tools, relative lack of *Olivella* beads, absence of *Haliotis* shell ornaments, small- to medium-sized projectile points, bedrock mortars, unshaped pestles, and flexed burials with few grave goods.

The Madera Phase has been identified as being between A.D. 1500 and 1850. This phase is marked by steatite disc beads and other steatite objects, small points, bedrock mortars, cobble pestles, various types of *Olivella* beads, imported brownware pottery, and flexed burials and cremations with a large quantity of artifacts.

Prehistoric Resources—East Side of the San Joaquin River Region. See the discussion under Prehistory of the West Side of the San Joaquin River Region.

Prehistory of the West Side of the San Joaquin River Region. Although early Holocene (10,000 to 12,000 years ago) peoples probably inhabited or passed through the San Joaquin River Region, few indications of their activities have been discovered, probably due to deep burial beneath accumulated silt. Examples of early Holocene cultural remains are known from the Tulare Basin in the southern San Joaquin Valley. Based on typological similarities with artifacts recovered in other parts of the western United States (fluted-point tradition), early occupation (Phase I) of the Tulare Basin may date to 11,500 years ago (Moratto, 1984). The earliest radiocarbon dates available for material excavated in the Tulare Basin (Buena Vista Lake) are 8,250 and 7,650 years ago (Meighan et al., 1988).

Although more recent work has been conducted in the region, the chronology derived from the excavation sites within the San Luis Reservoir area still provides a useful general framework. The earliest period identified has been called the Positas Complex, dating from approximately 3300 to 2600 B.C. The complex is characterized by small shaped mortars, cylindrical pestles, milling stones, perforated flat cobbles, and spire-lopped *Olivella* beads.

The Pacheco Complex is dated from approximately 2600 B.C. to A.D. 300 and is characterized by foliate bifaces, rectangular shell ornaments, and thick rectangular *Olivella* beads in the early phase and spire-ground *Olivella* beads, perforated canine teeth, bone awls, whistles, grass saws, large stemmed and side-notched points, milling stones, mortars, and pestles in the later phase.

A period known as the Gonzaga Complex has been identified between approximately A.D. 300 and 1000. Traits dating from this period include extended and flexed burials, bowl mortars, shaped pestles, squared and tapered-stem points, few bone awls, distinctive shell ornaments, and thin rectangular, split-punched, and oval *Olivella* beads.

The Panoche Complex is dated from approximately A.D. 1500 to 1850 and is recognized by large circular structures (pits), flexed burials and primary and secondary cremations, varied mortars and pestles, bone awls, whistles, small side-notched points, clamshell disk beads, and other types of beads (Moratto, 1984).

These complexes appear to indicate occupation of the valley by people engaged in acorn gathering and hunting. Material found in Pacheco to Panoche strata indicates a trade relationship with people of the Delta, the south coast, and southern inland areas.

Prehistoric Resources—West Side of the San Joaquin River Region. The following discussion combines information for both the east and west sides of the San Joaquin River Region.

Calaveras County. Of approximately 1,527 sites recorded within Calaveras County, 598 are historic sites or have historic components. The estimated amount of land surveyed for cultural resources totals 10 to 15 percent. The overall amount of significant disturbance by development in Calaveras County is low, with small towns scattered throughout the county as well as a few reservoirs. The gold rush and later mining, however, probably disturbed or destroyed many sites.

Prehistoric site types include milling stations, intaglios, rock shelter sites, habitation sites, burials, lithic scatters, tool scatters, quarries, temporary camps, rock art, and house pits. Recorded sites are found in the highest density along the Stanislaus River, North Fork Stanislaus River, Mokelumne River, and along foothill and mountain creeks and ridge flats.

Fresno County. Of the 2,891 sites recorded within Fresno County, 288 are historic sites or have historic components. The estimated amount of land surveyed for cultural resources is approximately 5 percent. The overall amount of significant disturbance in Fresno County is low, with few large centers of development, but with a large amount of disturbance from agricultural activities.

Prehistoric site types that have been recorded include occupation sites with midden and house pits, temporary camps, milling stations, lithic scatters, quarries, cemeteries, pictographs and petroglyphs, trails, rock cairns, and rock shelter sites. Recorded sites are densest along the San Joaquin, Kings, and South Fork Kings rivers; along Fancher, White, Panoche, and Dinkey creeks; in the areas around Shaver, Huntington, and Millerton lakes; on ridge flats; and along mountain creeks and meadows.

Madera County. Of 2,074 sites recorded within Madera County, 31 are historic or have historic components. The estimated amount of land surveyed for cultural resources totals approximately 1 to 2 percent. The overall degree of significant disturbance in Madera County is low, with few large centers of development.

Prehistoric site types that have been recorded within Madera County include lithic scatters, milling stations, occupation sites, house pits, acorn granaries, quarries, and petroglyphs. Recorded sites are densest along the Fresno, San Joaquin, and Chowchilla rivers; along Willow Slough; in the areas of Millerton and Bass lakes; in Crane Valley; near the Devils Postpile National Monument; and along mountain creeks, meadows, and ridge flats.

Mariposa County. Within Mariposa County, 408 of the 1,264 sites recorded are historic sites or have historic components. An estimated 5 percent of the land has been surveyed

for cultural resources. The overall amount of significant disturbance may be rated as low, with few towns and no large areas of development.

The types of prehistoric sites recorded in Mariposa County include milling stations, rock art, lithic scatters, occupation sites, burials, house pits, tool scatters, shard scatters, temporary camps, and rock shelter sites. Recorded sites are found in the highest density along creeks, along the Merced River, and within Yosemite National Park.

Merced County. Of approximately 341 sites recorded within Merced County, 25 are historic or have historic components and an estimated 2 percent of the land has been surveyed for cultural resources. The overall degree of disturbance may be rated as low, with few large cities. Significant disturbance, however, as a result of agriculture has occurred. Resources have also been affected by construction of reservoirs and inundation.

Prehistoric sites recorded within Merced County include lithic scatters, tool scatters, house pits, milling stations, temporary camps, habitation sites, burials, intaglios, and rock shelter sites. Because of the small number of recorded sites in Merced County, areas of high site density are not readily discernible.

San Joaquin County. Within San Joaquin County, 249 sites have been recorded, 60 are historic sites or have historic components. The estimated amount of land surveyed for cultural resources is approximately 5 percent. The overall degree of disturbance may be rated as low to moderate, with a few large areas of development.

Prehistoric sites recorded in the county include lithic scatters, tool scatters, occupation sites, milling stations, burials, and temporary camps. Recorded sites occur in the highest density along the San Joaquin and Mokelumne rivers.

Stanislaus County. Of 350 sites recorded within Stanislaus County, 70 are historic or have historic components. Approximately 3 percent of the land has been surveyed for cultural resources. The overall degree of disturbance may be rated as low, with few large centers of development.

Prehistoric sites recorded include lithic scatters, occupation sites, tool scatters, rock art, quarries, milling stations, burials, house pits, temporary camps, intaglios, rock shelter sites, rock alignments, and fire-affected rock scatters. Recorded sites occur in the highest density along the Stanislaus, Tuolumne, and San Joaquin rivers and along smaller creeks.

Tuolumne County. A total of 3,540 sites have been recorded within Tuolumne County, including historic sites or sites that have historic components. The estimated amount of land surveyed for cultural resources is approximately 10 percent, most of which is on National Forest lands. The overall degree of disturbance may be rated as low, with few large centers of development.

The types of prehistoric sites recorded within Tuolumne County include milling stations, lithic scatters, occupation sites, tool scatters, temporary camps, burials, quarries, and rock shelter sites.

Recorded sites are found in the highest density along the Stanislaus and Tuolumne rivers and along creeks and ridge flats in the Sierra Nevada foothills.

History of the East Side of the San Joaquin River Region. The east side of the San Joaquin River Region is characterized by both agricultural settlement and mining. Agricultural activities in the east side of the San Joaquin River Region are based on the establishment and development of commercial crops, accessibility to markets, new farming techniques, and irrigation. Mining activities in the eastern portion of this region (parts of Calaveras, Mariposa, and Tuolumne counties) are related to the gold rush of the mid-1800s and the subsequent mining activities since the discovery of gold in the Sierra Nevada foothills. The economy of the east side of the region has been based on mining, agriculture, and commercial services since the late 1800s. Historic resources are related to the settlement of the east side of the region and include mining features, homesteads, economic/ industrial facilities, residential properties, commercial establishments, and government facilities.

Historic-Period Resources—East Side of the San Joaquin River Region. Table II-2 shows the number of resources listed in the NRHP, California Historic Landmarks, California Inventory of Historic Resources, and California Points of Historical Interest by county in the San Joaquin River Region. The following discussion includes only those resources listed in these sources.

TABLE II-2

NUMBER OF HISTORIC RESOURCES IN THE SAN JOAQUIN RIVER REGION

County	Number of Properties in the National Register of Historic Places	Number of California Historic Landmarks	Number of Sites in California Inventory of Historic Resources	Number of California Points of Historical Interest
Calaveras	13	42	56	4
Fresno (eastern portion)	32	7	33	12
Fresno (western portion)	2	1	9	2
Madera	1	0	10	6
Mariposa	29	8	15	0
Merced	12	5	13	7
San Joaquin	31	23	28	8
Stanislaus	17	5	12	7
Tuolumne	19	20	79	4

Calaveras County. Historic resource themes found in Calaveras County include architecture, economic/industrial, exploration/settlement, government, religion, and social/education. Thirteen properties are listed in the NRHP, 42 properties are California Historic Landmarks, and 4 properties are considered California Points of Historical Interest. Thirteen historic resources have been inundated by New Melones Reservoir. New Melones Dam and Reservoir are Reclamation facilities. Over 400 historic sites were documented in the New Melones Reservoir project area, including many significant resources. Resources include ranches, placer and hard rock mining sites and features, trash scatters, flumes, a wagon and rail roads, and a wooden bridge. Listed historic/architectural resources along the Tuolumne River below the New Melones Dam include the Central Ferry Site, which is north of Green Spring Run, and the O'Byrnes Ferry Historic Monument. These resources are shared with Tuolumne County.

Fresno County (Eastern Portion). Historic resource themes found in the part of Fresno County within the east side of the region include architecture, arts/leisure, economic/industrial, exploration/settlement, military, religion, and social/education. Of the 32 properties listed in the NRHP, 7 are California Historic Landmarks, and 12 are considered California Points of Historical Interest. One historic/architectural resource may exist in the vicinity of the Friant-Kern Canal and may be associated with the storage of explosives used for construction of the Friant Dam. No other historic/architectural resources exist in the vicinity of the Friant-Kern Canal, the Friant Dam, or Millerton Lake, which are Reclamation facilities within the part of Fresno County in this geographic subregion.

Madera County. Architecture, economic/industrial, exploration/settlement, and religion are the historic resource themes found in Madera County. One property is listed in the NRHP, there are no California Historic Landmarks, and six properties are considered California Points of Historical Interest. No historic/architectural resources exist in the vicinity of the Friant Dam, Millerton Lake, or the Madera Canal, all of which are Reclamation facilities.

Mariposa County. Historic resource themes found in Mariposa County include arts/leisure, economic/industrial, exploration/settlement, government, religion, and social/education. Twenty-nine properties are listed in the NRHP, eight properties are California Historic Landmarks, and none are considered California Points of Historical Interest. No Reclamation facilities exist within Mariposa County.

Tuolumne County. Historic resource themes found in Tuolumne County include aboriginal, architecture, arts/leisure, economic/industrial, exploration/settlement, government, religion, and social/education. The NRHP lists 19 properties, 20 properties are California Historic Landmarks, and 4 properties are considered California Points of Historical Interest. Thirteen historic resources have been inundated by New Melones Reservoir. These resources are shared with Calaveras County and are discussed above.

CVP Facilities. No CVP facilities in this geographic region are considered historic resources.

History of the West Side of the San Joaquin River Region. The west side of the San Joaquin River Region is characterized by agricultural settlement. The economy of the west side of the region has been agriculturally based since the late 1800s. Prior to irrigation, most of the agricultural products resulted from ranching and dry-farming. Subsequent to irrigation, new commercial crops were introduced. Historic resources related to the settlement of the west side include homesteads, economic/industrial facilities, commercial establishments, and government facilities.

Historic-Period Resources—West Side of the San Joaquin River Region. Table II-2 shows the number of resources listed in the NRHP, California Historic Landmarks, California Inventory of Historic Resources, and California Points of Historical Interest by county in the San Joaquin River Region. The resources described in the following section include only those listed in these sources.

Fresno County (Western Portion). Historic resource themes found in the part of Fresno County within the west side of the San Joaquin River Region include architecture, arts/leisure, economic/industrial, exploration/settlement, military, religion, and social/education. Two properties are listed in the NRHP, one property is a California Historic Landmark, and two are considered California Points of Historical Interest. No historic/architectural resources are found in the vicinity of the Delta-Mendota Canal, the Coalinga Canal, or the San Luis Canal, which are Reclamation facilities.

Merced County. Historic resource themes in Merced County include aboriginal, architecture, economic/industrial, exploration/settlement, government, and religion. Twelve properties are listed in the NRHP, five properties are California Historic Landmarks, and seven properties are California Points of Historical Interest. No historic/architectural resources exist in the vicinity of the Delta-Mendota Canal, the B. F. Sisk San Luis Dam, the San Luis Reservoir, or the San Luis Canal, all of which are Reclamation facilities within Merced County.

San Joaquin County. San Joaquin County's historic resource themes include architecture, economic/industrial, exploration/settlement, military, religion, and social/education. Of the 31 properties listed in the NRHP, 23 are California Historic Landmarks, and 8 are considered California Points of Historical Interest. No historic/architectural resources exist in the vicinity of the Tracy Pumping Plant or the Delta-Mendota Canal, both of which are Reclamation facilities.

Stanislaus County. Aboriginal, economic/industrial, and exploration/settlement are the historic resource themes found in Stanislaus County. Seventeen properties are listed in the NRHP, five are California Historic Landmarks, and seven are California Points of Historical Interest. The former right-of-way for the Patterson and Western Railroad, which was constructed in 1916, bisects the Delta-Mendota Canal, the only Reclamation facility within Stanislaus County. However, there is no evidence that the right-of-way still exists.

CVP Facilities. No CVP facilities in this geographic subregion are considered historic resources.

Ethnographic Overview. The following ethnographic overview pertains to the eastern and western portions of the San Joaquin River Region.

Yokuts. "Yokuts" is a term applied to a large and diverse number of people inhabiting the San Joaquin Valley and Sierra Nevada foothills of central California. The Yokuts culture consists of three primary divisions, corresponding to gross environmental zones: the Southern San Joaquin Valley Yokuts, the Northern San Joaquin Valley Yokuts, and the Foothill Yokuts.

The Yokuts languages, of which there are three subdivisions, belong to the Yokutsan family, or Penutian stock (Shipley, 1978). Each of the primary Yokuts divisions included several dialects.

The Southern Valley Yokuts inhabited the southern San Joaquin Valley from about Fresno to the Tehachapi Mountains (Wallace, 1978b). The Northern Valley Yokuts lived in the northern San Joaquin Valley from around Bear Creek north of Stockton to the bend in the San Joaquin River near Mendota (Wallace, 1978c). The Foothill Yokuts inhabited the western slopes of the Sierra Nevada foothills from about the Fresno River to the Kern River (Spier, 1978b). No Yokuts tribal organization encompassed the whole of the peoples speaking Yokutsan languages, nor was there even a tribal organization that encompassed an entire primary division, such as Foothill Yokuts. These are linguistic and geographic designations only. The largest political entity among the Yokuts was the tribe.

In general, the Yokuts were seasonally mobile hunter-gatherers with semipermanent villages. Seasonal movements to temporary camps were made to exploit food resources in other environmental zones. The Southern Valley groups were adapted to a lake-slough-marsh environment and relied most heavily on fish, waterfowl, roots (especially tule roots), seeds, mussels, turtles, shellfish, and rabbits. However, consumption of large mammals and insect species was limited. Acorns were not readily available and therefore were not as large a staple food source as among many other California Indians. In contrast, the Northern Valley Yokuts relied heavily on acorns as a food staple, along with salmon and other fish. The Foothill Yokuts' primary foods were deer, acorns, pine nuts, and other resources found in the foothill zone.

The Yokuts first came into contact with Europeans when Spanish explorers visited the area in the late 1700s, possibly followed by expeditions to recover Indians who had escaped from the missions. The Northern Valley Yokuts were far more affected by missions than were the other groups. The loss of individuals to the missions, the influence of runaway neophytes, various epidemics in the 1800s, and the arrival of settlers and miners all contributed to the disintegration of Yokuts culture.

Miwok. "Miwok" is a term applied to a large and diverse number of peoples inhabiting coastal and central California areas. The Miwok cultures include three primary divisions, corresponding to gross environmental zones: the Coast Miwok, the Lake Miwok, and the Eastern Miwok.

The Miwok languages (it is believed there were seven) belong to the Miwokan subfamily of the Utian family, or Penutian stock (Shipley, 1978). Each of the primary Miwok divisions included several dialects.

The Lake Miwok inhabited the area from the southeastern tip of Clear Lake to Pope Valley on the south, and Cobb Mountain on the west to the headwaters of Putah Creek on the east (Callaghan, 1978). The Coast Miwok lived in the area from Duncan's Point north of Bodega Bay south to San Pablo Bay, and east almost to the Napa River (Kelly, 1978). The Eastern Miwok included five separate groups (Bay, Plains, Northern Sierra, Central Sierra, and Southern Sierra) that ranged over the area from Walnut Creek and the Delta, the lower Mokelumne and Cosumnes rivers and the Sacramento River from Rio Vista to Freeport (south of Sacramento), the foothill and mountain areas of the upper Mokelumne and Calaveras river drainages, the upper Stanislaus and Tuolumne river drainages, and the upper Merced and Chowchilla river drainages, respectively (Levy, 1978b).

No Miwok tribal organization encompassed all the peoples speaking Miwokan languages, nor was there even a tribal organization that encompassed an entire primary division, such as Coast Miwok. These are linguistic and geographic designations only. The largest political entity among the Miwok was the tribelet. Some groups also had a female leader, usually the wife of the chief.

In general, the Miwok were seasonally mobile hunter-gatherers with semipermanent villages. Acorns were the staple food resource among all the groups. Other important food sources were buckeye, seeds, bulbs, pine nuts, deer, elk, rabbits, squirrels, fowl, salmon and other fish, bear, and insects. The Coast Miwok also relied heavily on mussels, clams, and crab but did not eat sea mammals.

Early contact between Miwok and Europeans occurred first in the coastal areas as early as 1579, with the visit of Sir Francis Drake, and gradually moved inland. Miwok of inland areas came into contact with Spanish explorers in the late 1700s. By 1776, Mission San Francisco, and afterwards other nearby missions, was forcefully taking Miwok converts. In the middle to late 1800s with the arrival of settlers, ranchers, and miners, the Miwok were forced from their land, killed, and fell victim to various epidemics. These events greatly reduced Miwok populations.

Monache. The Monache, or Western Mono, are six separate groups who are linguistically affiliated. Generally, the Monache are distinguished from the Foothill Yokuts principally by language and location, rather than by cultural traits. At least two of the Monache groups are so named rather arbitrarily, appearing transitional between Western Mono and Yokut, and even being bilingual. The Monache language is classified within the Numic family, or Uto-Aztecan stock, found in California only with the Monache and Eastern Mono. The primary sources of ethnographic information on the Monache are Gayton (1948) and Gifford (1932). These and other sources are summarized in Spier (1978a), which is the primary source of this synopsis.

In general, the Monache lived on the west slopes of the Sierra Nevada, between 3,000 and 7,000 feet elevation; however, they ranged over a much wider area, including the eastern slopes of the Sierra Nevada. Monache groups were seasonally mobile hunter-gatherers. Acorns, collected in the foothills of the western side of the Sierra Nevada, were their dietary staple. The acorns were collected in large quantities and stored for the winter in elevated granaries in the villages. A wide range of other plant and animal resources were also used. These include deer, bear, rodents,

birds, insects, manzanita berries (for a beverage), seeds, honey, and fish. Fish were either harpooned, caught in weirs, or stunned with poison. The Northfork Monache crossed to the east side of the Sierra Nevada to collect pinyon pine nuts and yucca roots. These were traded to the other Monache groups, as well as to Yokuts (Spier, 1978a).

Kroeber (1939) believed that the areas of the Monache and Yokuts were among the most heavily populated areas in California previous to Euroamerican contact. It has been estimated that up to approximately 180 individuals per square mile may have inhabited this area. Kroeber (1925) estimated that by 1910, only 6 to 9 percent of this number survived.

Each large village of the six Monache groups had chiefs of limited power. The position of chief was inherited through the males. In addition to this system, the North Fork Monache had moieties that were headed by patrilineally derived chiefs. No political structure beyond that of the village, however, existed.

The Monache believed in supernatural totemic spirits that might be used by people with the right knowledge. One with such knowledge might become a shaman. Shamans were thought to have the power to cure or harm others.

The Monache produced twined basketry (including cradles), steatite cooking vessels, and ceramic vessels (coil method, fired) besides the usual array of lithic and bone implements.

Tulare Lake Region

The Tulare Lake Region includes Kings, Tulare, and Kern counties and encompasses portions of the southern San Joaquin Valley and the southern Sierra Nevada foothills and mountains. For the prehistory and history sections of this appendix, the region has been divided into east and west sides, which are separated by State Highway 99, with Kern County straddling the boundary. The "Prehistoric Resources" and the "Ethnographic Overview" sections are combined for the east and west sides.

Prehistory of the East Side of the Tulare Lake Region. The archeology of the Tulare Lake Region is among the least known in the state. Current interpretations of the prehistory of this area are based largely on excavations of sites near Buena Vista and Tulare lakes. Much of the culture chronology established for the Tulare Lake Region is based on comparisons with other regions of the state, such as the Delta, and few absolute dates are available.

Based on typological similarities with artifacts recovered in other parts of the western United States (fluted-point tradition), early occupation (Phase I) of the Tulare Lake Region may date to 11,500 years ago (Moratto, 1984). The earliest radiocarbon dates available for material excavated in the Tulare Lake Region (Buena Vista Lake) are 8,250 and 7,650 years ago (Meighan et al., 1988).

Interpretations of later phases of occupation in the Buena Vista and Tulare lakes area are based on information obtained from the excavation of burial sites. Phase II occupation, beginning

approximately 4,500 years ago, is characterized by extended burials lying supine or prone, with no burial goods. This phase of occupation appears to be roughly coeval with the Early Horizon culture seen in the Delta.

Phase III occupation, 3,000 to 1,500 years ago, is characterized by semiflexed burials lying supine and with a few burial goods. The people of this phase appear to have strong cultural links to the Delta area and may be ancestral Yokuts (Moratto, 1984).

The most recent occupation, Phase IV, dates from approximately A.D. 500 to the Historic Period. Burials from this phase are tightly flexed, on their side or supine, and include a moderate quantity of burial goods (Meighan et al., 1988). Objects not found locally suggest influence from the Santa Barbara coast area and from the southern interior area of California.

Prehistoric Resources—East Side of the Tulare Lake Region. See the discussion under Prehistory of the West Side of the Tulare Lake Region.

Prehistory of the West Side of the Tulare Lake Region. Archeological studies conducted in the Kern River/Lake Isabella area suggest that this area was occupied only fairly late in time, around A.D. 1000 (Moratto, 1984). Habitation sites in this area are found mostly in wooded areas, evidently to make use of acorn and pine nut resources. Although many sites have been recorded in the foothill zone, few have been excavated, resulting in an incomplete chronology for this region.

A more detailed chronology has been established for the high southern Sierra Nevada (Garfinkel and McGuire, 1980; Garfinkel, 1981). The earliest hypothesized period, called Period I, is dated to around 7000 B.C. to ca 5000 B.C. Period I is poorly defined and based on scant evidence. Possible sites of this period occur near high-elevation meadows and have been interpreted to be evidence of temporary hunting camps or bases for travel routes across the Sierras.

Period II (ca 5000 B.C. to 1300 B.C.) is manifested in the Kern Plateau by the Lamont Phase (4000 B.C. to 1200 B.C.) and is characterized by Pinto series points. This phase is thought to indicate a very sparse use of the area by small hunting groups and possibly by travel/trade parties.

Between 1300 B.C. and A.D. 600, Period III (on the Kern Plateau as the Canebrake Phase, 1200 B.C. to A.D. 600), is characterized by the presence of Elko series points (early) and Sierra Concave Base points (later). This period is thought to represent the first extensive occupation of the high-elevation areas and is associated with hunting, as well as probable use of plant resources, such as pinyon nuts.

Period IV (A.D. 700 to A.D. 1300), corresponding to the Sawtooth Phase (A.D. 600 to A.D. 1300) on the Kern Plateau, is manifested by an intensification of occupation, a shift to the use of the bow and arrow (smaller point types such as Rose Spring and Eastgate types [Rosegate series]), and use of bedrock mortars and pestles.

The last phase, known as Period V (A.D. 1300 to A.D. 1850), corresponds to the Chimney Phase on the Kern Plateau and is characterized by the greatest increase in population occupying the

uplands, a diversification of the location of sites, desert side-notched and cottonwood triangular projectile points, greater use of bedrock mortars and other ground stone (signifying a probable increase in pinyon and other plant resource utilization), pictographs, and glass trade beads.

Prehistoric Resources—West Side of the Tulare Lake Region. The following provides information for prehistoric resources from both east and west sides of the Tulare Lake Region.

Kings County. A total of 60 sites have been recorded within Kings County, including 4 that have historic components. The estimated amount of land surveyed for cultural resources totals less than 1 percent. Overall, the degree of disturbance may be rated as low, with few large centers of development, but with some substantial disturbance to archeological sites as the result of agricultural activities.

Prehistoric sites recorded within Kings County include occupation and burial sites, house pits, lithic scatters, milling stations, temporary camps, and charm stone caches. Recorded sites occur in the highest density along Garza Creek, Jacobs Slough, Kings River, Sand Ridge, Little Avenal Creek, and around Tulare Lake.

Kern County. Approximately 3,850 sites have been recorded within Kern County, some of which are historic or have historic components. The estimated amount of land surveyed for cultural resources totals approximately 5 percent. Overall, the degree of disturbance may be rated as low, with few large centers of development.

Prehistoric site types recorded within Kern County include lithic scatters, occupation sites, milling stations, artifact scatters, burials, rock rings, cairns, quarries, temporary camps, and rock art. Recorded sites are densest along the Kern River, in McKittrick Valley, in the Buena Vista Hills, in the Fremont Valley, at the confluence of the Kern and South Fork Kern rivers (Isabella Lake), at mountain-valley interfaces where creeks empty into the valley, and along mountain creeks and ridge flats.

Tulare County. Of 1,982 sites recorded within Tulare County, 125 are historic or have historic components. Approximately 2 percent of the land has been surveyed for cultural resources. Overall, the degree of disturbance may be rated as low, with few large centers of development.

Prehistoric site types identified in Tulare County include lithic scatters, milling stations, occupation sites, burials, artifact scatters, rock art, quarries, rock cairns, and rock rings. Recorded sites occur in the highest density along the Tule, South Fork Tule, Kern, and Kaweah rivers; Deer and Dry creeks; and mountain creeks, springs, and ridge flats.

History of the East Side of the Tulare Lake Region. The east side of the Tulare Lake Region is characterized by agricultural settlement. Agricultural activities are based on the establishment and development of commercial crops, accessibility to markets, new farming techniques, and irrigation. The economy of the east side of the region has been based on agriculture and commercial services since the late 1800s. Historic resources are related to the

settlement of the east side and include homesteads, economic/industrial facilities, residential properties, commercial establishments, and government facilities.

Historic-Period Resources—East Side of the Tulare Lake Region. Table II-3 shows the number of resources listed in the NRHP, California Historic Landmarks, California Inventory of Historic Resources, and California Points of Historical Interest by county in the Tulare Lake Region. The following discussion includes only those resources listed in these sources.

TABLE II-3

NUMBER OF HISTORIC RESOURCES IN THE TULARE LAKE REGION

County	Number of Properties in the National Register of Historic Places	Number of California Historic Landmarks	Number of Sites in California Inventory of Historic Resources	Number of California Points of Historical Interest
Kern	10	25	35	6
Kings	4	3	5	0
Tulare	30	8	9	0

Kern County. Historic resource themes found in the part of Kern County within the west side of the Tulare Lake Region include aboriginal, architectural, economic/industrial, exploration/settlement, government, military, religion, and social/education. Ten properties are listed in the NRHP, 25 properties are California Historic Landmarks, and 6 properties are considered California Points of Historical Interest. No historic/architectural resources are in the vicinity of the Friant-Kern Canal, which is the only Reclamation facility in the part of Kern County within this geographic subregion.

Tulare County. Historic resource themes found in Tulare County include economic/industrial, exploration/settlement, government, and social/education. Thirty properties are listed in the NRHP, eight properties are California Historic Landmarks, and none are considered California Points of Historical Interest. No historic/architectural resources are found in the vicinity of the Friant-Kern Canal, which is the only Reclamation facility within Tulare County.

CVP Facilities. No CVP facilities in the east side of the Tulare Lake Region are considered historic resources.

History of the West Side of the Tulare Lake Region. Agricultural settlement characterizes the west side of the Tulare Lake Region. The economy here has been agriculturally based since the late 1800s. Before irrigation, most of the agricultural products in the west side were the results of ranching and dry-farming. With irrigation, new commercial crops were

introduced. Historic resources related to the settlement of the area include homesteads, economic/industrial facilities, commercial establishments, and government facilities.

Historic-Period Resources—West Side of the Tulare Lake Region. Table II-3 shows the number of resources listed in the NRHP, California Historic Landmarks, California Inventory of Historic Resources, and California Points of Historical Interest by county in the Tulare Lake Region. The following discussion includes only those resources listed in these sources.

Kern County. Historic resource themes found in the part of Kern County within the west side of the Tulare Lake Region include aboriginal, architecture, economic/industrial, exploration/settlement, government, military, religion, and social/education. One property is listed in the NRHP, seven properties are California Historic Landmarks, and two properties are considered California Points of Historical Interest. No Reclamation facilities are located in the part of Kern County within this geographic subregion.

Kings County. Aboriginal, economic/industrial, exploration/settlement, and religion are the historic resource themes found in Kings County. Four properties are listed in the NRHP, three are California Historic Landmarks, and none are considered California Points of Historical Interest. The San Luis Canal, which is the only Reclamation facility within Kings County, has no historic or architectural resources in its vicinity.

CVP Facilities. No CVP facilities in the west side of the Tulare Lake Region are considered historic and architectural resources.

Ethnographic Overview. The following discussion pertains to both the eastern and western sides of the Tulare Basin.

Tubatulabal. The Tubatulabal lived in the area from Mt. Whitney to the north, Walker Pass to the east, and the San Joaquin Valley to the west. Much of this area is extremely mountainous, and the core area of settlement was the Kern and South Fork Kern river valleys. Linguistically, the Tubatulabal are considered a unique subgroup of the Uto-Aztecan language family. The primary ethnographic source for the Tubatulabal is Voegelin (1938), summarized by Smith (1978).

The Tubatulabal subsisted by hunting, gathering, and fishing, with pinyon pine nuts and acorns as their staples. The pine nuts were collected from the eastern slopes of the Sierra Nevada, while the acorns were collected primarily from the foothills west of the Sierra Nevada. A wide range of other plants and animals contributed to their diet (Smith, 1978).

Bands of Tubatulabal settled into semipermanent winter hamlets of two to six households along the Kern River Valley. During the warmer months, the Tubatulabal inhabited smaller, temporary camps. These camps were typically located at higher elevations to exploit the varied resources available in those areas and possibly to escape the summer heat.

At the time of contact with Euroamericans, circa 1850, the Tubatulabal population is estimated to have been 300 to 500 individuals. The Tubatulabal maintained a simple political organization,

with three independent bands among which intermarriage occurred. Each band had its own chief (Smith, 1978).

Tubatulabal religion was based on a belief in many supernatural spirits (in the form of both animals and humans). Dreams were interpreted, and shamans, who could be either men or women, had powers to cure the sick. Witches were feared and blamed for misfortune and death. Tubatulabal myths appear to be related to Great Basin motifs, rather than to California types. In technology, both coiled and twined basketry was produced, as well as pottery vessels and lithic tools.

Kitanemuk. The Kitanemuk are thought to have had close ties and cultural traits in common with the Tubatulabal, although very little information is available for the group. The Kitanemuk language is classified within the Serran language group, Takic family, Uto-Aztecan stock (Shipley, 1978), and is now extinct. The core area of the Kitanemuk people was the Tehachapi Mountains at the southern end of the San Joaquin Valley. It is believed that the Kitanemuk were assimilated into various missions, which effectively destroyed their culture. In the 1850s, a few Kitanemuk were apparently living at Fort Tejon and later at the Tule River Indian Reservation (Blackburn and Bean, 1978).

For further information, see the preceding descriptions of Yokuts and Monache.

North Coast Region

Because of the similarity between the North Coast and Trinity River Basin regions, the following discussion includes the Trinity River Basin in the discussion of the North Coast Region with regard to prehistory, history, and ethnography.

Prehistory of the North Coast. The North Coast Region consists of Del Norte, Humboldt, Mendocino, and Trinity counties. These areas include numerous and diverse environmental zones, Native American groups, and archeological complexes. Moratto (1984) has divided this large and diverse area into three archeological subregions: the Northwest Coast Subregion, which roughly takes in Del Norte, northern Humboldt, and northwest Trinity counties; the Eel River Subregion, which covers southern Humboldt, southwest Trinity, and northern Mendocino counties; and the Russian River/Clear Lake Subregion, which encompasses southern Mendocino, northern Sonoma, and Lake counties.

Fredrickson (1973) has delineated five periods of prehistory for this region, with individual archeological patterns and complexes proposed for the Russian River/Clear Lake subregion. Moratto (1984) has placed the other subregions within this five-period structure.

The earliest period, known as the Paleo-Indian Period (10,000-6000 B.C.), is manifested in the Russian River/Clear Lake subregion by the Post Pattern, which is characterized by fluted points, crescents, and an inferred emphasis on hunting in lakeshore environments. This period is not described in the other subregions.

The Lower Archaic Period (6000-3000 B.C.) is manifested in the Russian River/Clear Lake subregion by the Early Borax Lake Pattern, which is characterized by wide-stemmed projectile points, manos, and metates that may indicate greater emphasis on gathering seeds and less emphasis on hunting. Similar characterizations apply to the other two subregions in this period.

A period known as the Middle Archaic Period has been identified between 3000 B.C. and 1000 B.C. In the Russian River/Clear Lake subregion, this period is marked by the Late Borax Lake Pattern, which is characterized by concave base points, large leaf-shaped points, contracting stemmed points, and the introduction of the bowl mortar and pestle. The Northwest Coast and Eel River subregions are characterized in this time period by a continuation of the Early Borax Lake Pattern.

The Upper Archaic Period (1000 B.C.-A.D. 500) is manifested in the Russian River/Clear Lake subregion by the Berkeley Pattern, which is characterized by the complete replacement of manos and metates with mortars and pestles, shouldered lanceolate, and contracting-stem points. This period may have witnessed the entry of the ethnographically known Lake Miwok into this area. The Upper Archaic Period in the other two subregions is not well defined (Moratto, 1984).

The last phase is known as the Emergent Period and dates from A.D. 500 to A.D. 1800. In the Russian River/Clear Lake subregion, this period is known as the Augustine Pattern, which is characterized by small corner-notch, side-notch, and barbed projectile points and slab hopper mortars. The Northwest Coast and Eel River subregions may be similarly characterized and are termed the Gunther Pattern and the Augustine Pattern, respectively.

Prehistoric Resources—North Coast. The following provides information for prehistoric resources from the North Coast Region.

Del Norte County. Of the 315 archeological sites recorded within Del Norte County, 186 are historic or have historic components. The estimated amount of land surveyed for cultural resources totals approximately 2 percent, most of which is U.S. Forest Service forest land. Overall, very little of the county has been significantly disturbed.

Prehistoric site types recorded include habitation sites, temporary camps (such as fishing camps), lithic scatters, milling stations, dance house sites, cemeteries, and ceremonial sites. Prehistoric sites have been recorded in highest densities along the Smith River, its tributaries, inland creeks and ridge flats, and along the coast where rivers and creeks empty into the ocean.

Humboldt County. Of the 956 archeological sites recorded within Humboldt County, 203 are historic or have historic components. The estimated amount of land surveyed for cultural resources totals around 2 percent, most of which is along the coastal strip and inland on Service forest lands. Overall, little of the county has been significantly disturbed.

Prehistoric site types recorded include habitation sites, seasonal camps, ceremonial sites, quarries, milling stations, lithic scatters, and petroglyphs. Recorded sites are found in the highest density along the major rivers, inland creeks and ridge flats, and along the coast where rivers and creeks empty into the ocean.

Mendocino County. Within Mendocino County, 248 of the 2,815 recorded sites are historic or have historic components. An estimated 5 percent of the county was surveyed for cultural resources, most of it inland U.S. Forest Service forest lands. Overall, little of the county has been significantly disturbed.

Prehistoric site types recorded include habitation sites, lithic scatters, quarries, milling stations, dance house sites, and petroglyphs. Recorded sites are found in the highest density along the Russian and Eel rivers, on ridge flats, in inland valleys such as Williams Valley, and along the coast where rivers and creeks empty into the ocean.

Sonoma County. Of the 2,084 sites that have been recorded within Sonoma County, 361 are historic or have historic components. Approximately 5 percent of Sonoma County has been surveyed for cultural resources. Overall, the degree of significant disturbance in the county may be rated as moderate, with the greatest amount of development occurring in the southern half of the county.

Prehistoric site types recorded include habitation locations, lithic scatters, quarry sites, petroglyphs, hunting blinds, artifact scatters, and house pits. Recorded sites are densest along inland and upland watercourses (i.e., Russian River and Sulphur Creek), ridge flats, and coastal locations such as Bodega Bay and Gualala Point.

Trinity County. Of the 1,370 sites recorded within Trinity County, 465 are historic or have historic components. Approximately 10 percent of the county was surveyed for cultural resources, most of it Service forest lands. However, many of the survey areas were subjected to less than intensive coverage. Overall, significant disturbance within Trinity County may be rated as low, with some areas of notable exception, such as inundated reservoirs (i.e., Whiskeytown-Shasta-Trinity National Recreation Area).

Prehistoric site types recorded include occupation sites, temporary camp sites, milling stations, rock shelter sites, cemeteries, lithic scatters, quarries, and petroglyphs. Recorded sites are found in the highest density along foothill streams and rivers (i.e., Trinity River and forks), along mountain creeks, and on mountain ridge flats.

History of the North Coast Region. This geographic subregion is characterized by settlement based on the use of natural resources, specifically mineral exploration, forestry, and fisheries. The economy has been based on these industries since the late 1800s. Urban and suburban development has continued in the southern part of the geographic subregion (notably Sonoma County) since the 1950s. Historic resources, related to the settlement of the subregion, include homesteads, economic/industrial facilities, commercial establishments, and government facilities.

Historic-Period Resources—North Coast Region. Table II-4 shows the number of resources listed in the NRHP, California Historic Landmarks, California Inventory of Historic Resources, and Points of Historical Interest by county in the North Coast Region. The resources described in the following section include those that are included in these sources.

TABLE II-4

NUMBER OF HISTORIC RESOURCES IN THE NORTH COAST REGION

County	Number of Properties in the National Register of Historic Places	Number of California Historic Landmarks	Number of Sites in California Inventory of Historic Resources	Number of California Points of Historical Interest
Del Norte	8	7	14	2
Humboldt	45	13	58	7
Mendocino	31	7	7	5
Sonoma	50	27	33	1
Trinity	5	2	3	2

Del Norte County. Aboriginal, economic/industrial, exploration/settlement, government, military, and social/education resources themes are found in Del Norte County. Eight properties are listed in the NRHP, seven are California Historic Landmarks, and two are considered California Points of Historical Interest. No Reclamation facilities are located in Del Norte County.

Humboldt County. Historic resource themes found in Humboldt County are aboriginal, architecture, arts/leisure, economic/industrial, exploration/settlement, military, and social/education. The NRHP lists 45 properties, 13 properties are California Historic Landmarks, and 7 are considered California Points of Historical Interest. Reclamation has no facilities in Humboldt County.

Mendocino County. Historic resource themes in Mendocino County are aboriginal, architecture, exploration/settlement, military, religion, and social/education. Thirty-one properties are listed in the NRHP, seven properties are California Historic Landmarks, and seven are considered California Points of Historical Interest. Reclamation has no facilities in Mendocino County.

Sonoma County. Aboriginal, architecture, arts/leisure, economic/industrial, exploration/settlement, government, military, religion, and social/education resource themes are found in Sonoma County. The NRHP lists 50 properties, 27 properties are California Historic Landmarks, and one property is considered a California Point of Historical Interest. No Reclamation facilities exist within Sonoma County.

Trinity County. Economic/industrial and social/education historic resource themes are found in Trinity County. The NRHP lists five properties, two properties are California Historic Landmarks, and two are considered California Points of Historical Interest. Two historic sites are adjacent to Lewiston Lake, which is a Reclamation facility. No historic/architectural resources are in the vicinity of the other Reclamation facilities in Trinity County.

CVP Facilities. No CVP facilities in the North Coast Region are considered to have historic and architectural resources. Information on CVP facilities in the Trinity River Basin Region may be found in the Surface Water Supplies and Facilities Operations Technical Appendix.

Ethnographic Overview. The following discussion pertains to the North Coast Region.

Yuki, Huchnom, and Coast Yuki. The Yuki, Huchnom, and Coast Yuki inhabited the areas of the upper Eel River drainage (the core of which was Round Valley), the south Eel River drainage, and the coastal strip from north of Rockport to just north of Fort Bragg, respectively. These groups spoke three dialects of Yuki, which is the language of the Yukian family (grouped with Wappo) (Miller, 1978, 1979). The Yuki language has no definitely known affiliation with any major language stock of North America. The primary sources of ethnographic information about the Yuki are Powers (1877), Kroeber (1925), and Foster (1944), which are summarized in Miller (1978, 1979).

The Yukian groups were hunter-gatherers whose dietary staples were deer, acorns, and salmon. A wide range of other plant and animal resources were also exploited, however.

Intensive contact with Europeans did not occur until 1856. Shortly thereafter, the Yukian groups, together with several other northern California groups, were placed in the Round Valley Reservation. As a result of the Euroamerican settlers killing the Yuki, the aboriginal culture was almost entirely destroyed in a short time. It has been estimated that in 1850 there were 6,880 Yuki, 2,100 Huchnom, and 750 Coast Yuki (Miller, 1978).

The Yukian people were organized by nuclear families, which were grouped into small villages with local chiefs. A number of these small villages then formed tribelets, which in turn formed the principal tribal subdivisions. The three Yukian groups resembled each other more than other tribes but also had many differences. The Huchnom culture, for example, included many Pomoan traits, and the Coast Yuki had a slightly different political organization and kinship structure.

In regard to religion, the Yuki believed in an anthropomorphic creator and an afterlife for those who were good. They also believed in lesser spirits associated with various geographic features. Shamans, as well as nonshaman doctors, treated illness.

Technologically, the Yukian groups used an array of stone and bone implements, decorated coil basketry, undecorated twined ware, and bows and arrows. Most notably, none of the Yukian groups used watercraft (Miller, 1978).

Chimariko. The Chimariko were aboriginal to a 20-mile-long canyon of the Trinity River in Trinity County. Their territory extended from approximately the confluence of the Trinity River with the South Fork Trinity River in the northwest to Big Bar in the southeast. Although the Chimariko language is now extinct, early ethnography recorded some words, and the language is thought to be of Hokan stock. Sources for ethnographic information about the

Chimariko include Driver (1939), Powers (1877), Dixon (1910), Harrington and Merriam (1967), and Kroeber (1925). These sources are summarized in Silver (1978a), which is the source of this synopsis.

The Chimariko lived in an area with abundant natural resources that provided plenty of food. The staples of their diet were salmon and acorns; however deer, elk, bear, pine nuts, seeds, berries, roots, and small mammals were also important food resources.

Contact with Euroamericans began in 1820 as trappers explored the area. By the 1850s, gold miners had moved into Chimariko territory and began systematically killing Chimariko. Survivors of the massacres moved away to the upper Salmon River or to Scotts Valley.

Because of the near total extinction of the Chimariko and their culture at an early date, little is known of their social organization. The largest social unit was the village. Each village had a headman, a hereditary, lifelong position passed through the male line. Status in Chimariko society was attained through wealth or a combination of wealth and birth.

Only fragmentary data are available on Chimariko religion and myths. It is believed that the dog was the most powerful being, and fragments of a creation myth also survive. Curing of illnesses was accomplished through a shaman or an herb doctor (it was believed that illness was caused by the presence in the body of a foreign object that could be sucked out or treated with herbs).

The Chimariko produced twined basketry, unfired clay vessels, clay play objects, and steatite bowls, as well as various standard lithic and miscellaneous tools.

Tolowa. The Tolowa territory extended along the coast from the Winchuck River (just north of the California-Oregon border) in the north, to about Wilson Creek (south of Crescent City) in the south, and up to 15 miles inland. Principal villages were located along the coast. The Tolowa language is classified as being within the Athabaskan family, Na-Dene Stock (Shipley, 1978), related to Hupa, Mattole, and others. The primary ethnographic sources available for information on the Tolowa are Drucker (1937), Du Bois (1936), and Gould (1966). These and other sources are summarized in Gould (1978), which is the main source for this synopsis.

The Tolowa spent most of the year at their permanent villages along the coast, relying primarily on resources from the sea and on stored foods. In late summer, they moved along the beaches to catch smelt. They later moved inland to collect acorns and catch salmon and returned to their permanent villages by late November (Gould, 1978). Like the Yurok, Karok, and Hupa, the Tolowa built large redwood plank houses and sweat houses in their permanent villages.

Precontact population of the Tolowa is unknown, but it has been variously estimated at 450, 1,000, and 2,400 individuals. Gould (1978) favors the larger number, citing favorable environmental conditions and abundant archeological remains. Their population declined substantially after 1850 because of introduced diseases, such as measles and cholera, and attacks by Euroamericans.

The Tolowa did not have a formal ruling council or chief but, rather, a headman whose prestige was based on wealth. Wealth was defined as the possession of various imported, nonsubsistence items (e.g., woodpecker scalps and Dentalium shell beads). These wealth items could be acquired in many ways, such as through bride price, trade, indemnities, gambling, and so on.

Shamans in Tolowa society were generally women or transvestite males. Shamans also may have been capable of causing harm and therefore may have been feared.

In addition to the usual lithic and bone tools made by most California Native Americans, the Tolowa also specialized in some technologies more common in northwest California, such as river and seagoing redwood canoes, woodworking tools, harpoons, nets, and large plank structures.

Karok. The Karok lived primarily along the middle course of the Klamath River from about Seiad in the north to Bluff Creek (north of Weitchpec) in the south. Their territory also included portions of many of the adjoining creeks and rivers. The language spoken by the Karok has been classified as belonging to the Hokan stock, although no clearly related languages have been identified (Shipley, 1978). The principal ethnographic sources for the Karok are Harrington (1932), Kroeber and Barrett (1960), and Driver (1939). These and other sources have been discussed and summarized by Bright (1978), which is the source for this synopsis.

The Karok have been defined linguistically, because their culture was almost indistinguishable from neighboring Yurok and Hupa. Additionally, the Karok people did not recognize any political or social unity among themselves at levels higher than individual villages. No formal ruling council or chief existed in Karok society. Informal power was held by a headman, who had prestige acquired through wealth. Social order was maintained through the family and through village interaction.

As with many other northwest California groups, wealth was defined as the possession of various imported, nonsubsistence items (e.g., woodpecker scalps and Dentalium shell beads). These wealth items could be acquired in many ways, such as hunting, bride price, trade, indemnities, and gambling.

The Karok were hunter-gatherers who relied primarily on acorns and salmon as staples. Deer was the most prized game; however, elk, bear, and rodents were also hunted. Seeds, nuts, bulbs, and a wide variety of other plant foods were also collected. Fishing was most often undertaken with the use of a wooden platform on the edge of a stream, with a net placed or dipped in the water to catch the fish. Sometimes fish were harpooned.

Another feature shared with other northwest California native groups was the doctor or shaman. Men and women could be doctors.

Apart from the standard lithic and bone implements produced by most California native groups, the Karok also specialized in woodworking, making wood (cedar) plank structures, seats, headrests, and eating utensils (Bright, 1978). Steatite dishes and twined basketry were also produced.

Although the Karok had been contacted by Euroamericans earlier, the first major interaction occurred beginning in 1850, when gold miners moved into Karok territory, burning their villages and killing the occupants. After this intrusion, the Karok dispersed to other areas, returning years later to find settlers on their former land. It has been estimated that in 1848 there were 2,700 Karok (Bright, 1978).

Hupa, Chilula, and Whilkut. The Hupa, Chilula, and Whilkut inhabited the lower course of the Trinity River, the lower portion of Redwood Creek, and the upper course of Redwood Creek and the middle stretch of Mad River, respectively. Linguistically, Hupa, Chilula, and Whilkut are considered three dialects of the Hupa language, Athabaskan family, Na-Dene stock (Shipley, 1978). Ethnographic information on the Hupa is plentiful, with Goddard (1903-1904), Powers (1877), Kroeber (1925), and Driver (1939) being the primary sources. Information about the Chilula and Whilkut is limited. For these peoples, Goddard (1914), Driver (1939), and Baumhoff (1958) are the best sources. These sources and others have been summarized by Wallace (1978a), which is the source of this synopsis.

Differences in subsistence strategies between the three groups were small and appear to have been largely determined by environmental variation. The Hupa relied heavily on salmon and acorns; however, they also used other fish, nuts, seeds, roots, deer, elk, rodents, and fowl. They did not eat insects or amphibians or reptiles (except turtles). The Chilula also ate salmon and other fish, but placed more emphasis on vegetable foods (e.g., acorns, seeds, and bulbs) and on hunting deer and elk. Little is known of Whilkut subsistence, but it is believed that it resembled that of the other two groups (Wallace, 1978a).

Although contacts with Euroamericans (e.g., trappers) had been made at earlier dates, intensive interactions began to occur in 1850. After 1850, when gold miners and settlers entered Hupa territory, a few conflicts occurred. However, in 1864, most of Hupa territory was made a reservation and the Hupa continued to live there, uninterrupted, until the present day. The present day "Hoopa Valley Tribe" continues many of the tribal traditions. The Hupa had one of the highest postcontact survival rates in the state and have become relatively prosperous in the 20th century. The Chilula, on the other hand, were massacred by settlers and deported. Returning deportees were then massacred by Lassik Indians. Survivors of these actions merged with the Hupa, eventually losing their dialect. The Whilkut history is similar to that of the Chilula, except that survivors returned to their homeland after 1870.

Like many native groups of the California northwest, the Hupa and Chilula had no formal chief or ruling council but rather individuals with prestige based on wealth. Wealth was defined in terms of the possession of nonsubsistence goods (usually imported items) gained through trade, gambling, and indemnities. No higher political entity existed other than that of the village. Unlike the Hupa, the Chilula did not have privately owned fishing locations. In other respects, however, they appeared to be quite similar in political and social organization. Little is known of Whilkut social structure.

The Hupa believed in supernatural beings and engaged in renewal ceremonies and individual supplications. Shamans were usually women. The Chilula were generally similar to the Hupa except that they apparently placed less emphasis on ceremonies of renewal. The Whilkut are

believed to have held religious beliefs different from those of the other two groups, but details have not been recorded (Wallace, 1978a). The Hupa excelled in woodworking and basket making (twined basketry). They made plank houses and sweat houses, wooden chests, bowls, seats, and other goods. Wooden platforms, weirs, or harpoons were used for fishing. Although the Hupa used redwood canoes (traded from the Yurok), they did not produce them. The Chilula were generally similar to the Hupa in material culture, with some minor differences such as not using canoes (Redwood Creek is too small). What is known of the Whilkut suggest some important differences in their material culture, such as different structure design.

Cahto. The Cahto inhabited the Cahto and Long valleys of Mendocino County, as well as the upper drainage of the South Fork Eel River. The Cahto language has been classified as belonging to the Athabaskan family, Na-Dene stock (Shipley, 1978). Although their language is grouped together with that of the Nongatl, Lassik, Wailaki, and Sinkyone, their culture more closely resembles that of the Pomo. The primary source for ethnographic information on the Cahto is Curtis (1907-1930), while Goddard (1907), Kroeber (1925), and Cook (1956) also contain some data for the group. These sources have been summarized by Myers (1978), which was used as the primary source for this synopsis.

For subsistence, the Cahto relied on salmon and acorns as staples, although these items were supplemented by a wide variety of foods, including deer, bear, mink, raccoon, rodents, birds, insects, seeds, and roots.

The first documented contact with Euroamericans occurred in 1851 when they were mentioned by a federal treaty officer. Beginning about 1856, violent incidents between the Cahto and settlers were common and resulted in at least one massacre of Cahtos. By the 1920s, the population had been reduced to approximately 50 individuals (Myers, 1978).

The Cahto did not appear to have a political structure encompassing more than the individual village, although the Long Valley villages (six villages) did have a collective name. Each village had a headman with limited powers. This was a hereditary position that was passed on patrilineally.

The religious life of the Cahto revolved around two powerful creator beings. Prayer was practiced frequently, and the Cahto believed that spiritual powers could be gained through contact with supernatural entities. Three kinds of shamans or doctors existed: sucking, singing and dancing, and bear.

In addition to the standard range of lithic and bone tools produced throughout California, the Cahto also made twined and coiled basketry; various traps and snares; and dwellings constructed of four upright posts in a shallow circular pit, supporting pine or spruce slabs, which were covered by bark. No canoes were used because waterways were too shallow, although simple rafts were employed. Besides nets and harpoons, fish were sometimes collected by stunning them with poisonous plants placed in the water (Myers, 1978).

Mattole, Nongatl, Sinkyone, Lassik, and Wailaki. The Mattole, Nongatl, Sinkyone, Lassik, and Wailaki, collectively known as the Southern Athabaskans, inhabited an

area in northwestern California along the coast, from just south of Bear River to just south of the Humboldt-Mendocino County line, and inland almost to the South Fork Trinity River. The languages of these groups have been classified within the Athabaskan family, Na-Dene stock. Wailaki, Nongatl, Lassik, and Sinkyone are considered dialects of the same language. It is unclear whether Mattole is also a dialect or a separate language. Ethnographic information about these groups is available in Kroeber (1925), Nomland (1938), Loeb (1932), and Essene (1942), among others. These sources were used in Elsasser's (1978a) summary, which is the primary source for this synopsis.

The Mattole lived in the area along the coast from Davis Creek in the north to Spanish Flat in the south. The Sinkyone inhabited the coastal strip from Spanish Flat in the north to Usal Creek in the south. The Nongatl held an inland area encompassing the Van Duzen River drainage, Yager Creek, portions of the upper Mad River and Eel River, and the Larabee Creek drainage. The Lassik lived in an area that included the Eel River from Dobbyn Creek to Kekawaka Creek and the headwaters of the North Fork Eel River and the Mad River. The Wailaki occupied the portion of Eel River from Kekawaka Creek to Big Bend Creek and parts of the North Fork Eel River.

Politically, the largest entity was the tribelet, a single group associated with a village and a territory. Each of the five groups was composed of multiple tribelets. Each tribelet had a headman of limited power, a position inherited patrilineally or acquired through wealth and prestige. Although wealth was a factor in social organization, much less emphasis was placed on it than among many of the other northwest California groups, such as the Yurok.

Primary vegetal resources included acorn, buckeye, manzanita, pine nuts, and berries. Although coastal groups hunted sea lions and collected mollusks and fish, they were not heavily dependent on these resources. Other food sources included deer, elk, small game, and salmon (salmon were obtained primarily by the Mattole and Sinkyone).

These southern Athabaskan groups were not intensively exposed to Euroamericans until approximately 1853, when the federal government began assigning them to reservations. In the ensuing years (especially 1861 and 1862), local settlers massacred some groups, with the Wailaki being particularly devastated.

Yurok and Wiyot. The Yurok inhabited the Pacific north coastal area, from about Trinidad to Crescent City, and spread inland along the Klamath River approximately 45 miles (Pilling, 1978). The Wiyot lived south of the Kurok from about Little River (just south of Trinidad) to the Bear River Mountains (north of Cape Mendocino), and inland to the crest of the coastal ranges (Elsasser, 1978b).

The Yurok and Wiyot languages are of Algic stock, a peripheral language stock related to the Algonquian group. The Wiyot language is now extinct (Shipley, 1978).

Because the Wiyot territory was almost entirely within a redwood zone and included few oak trees, less dietary emphasis was probably placed on the acorn (although acorns were probably traded or obtained on expeditions). Primary subsistence resources included salmon, mollusks,

surf fish, sea mammals, deer, elk, berries, and other plants and animals. Similar subsistence items were apparently used by the Yurok, although acorns were in greater abundance in their territory.

As with other northwest California Native American groups, no formal tribal organization existed, but society was stratified in terms of power and prestige gained through the accumulation of wealth. Wealth was defined in terms of possession of luxury goods, which were usually imported. Although many resources were held in common by the village, some locations, such as house sites and tobacco-growing plots, were owned by individuals or families. The groups' concept of disease and curing was also similar to that of other northwest California groups.

The Yurok and Wiyot excelled in woodworking crafts. Split-plank redwood houses (rectangular) were made, as were redwood dugout boats and many other items. Finely twined baskets and twined dome work hats were also produced.

Both the Wiyot and Yurok were adversely affected by Euroamerican contact. By the early 1850s, settlers were shooting Wiyot, and in 1860, approximately 250 Wiyot were massacred. Survivors of the massacre were placed on reservations. The Yurok fared somewhat better than did the Wiyot, although many were reduced to becoming wage laborers for settlers.

Pomo. The Pomo Indians of the north-central coast of California inhabited the area from just north of Fort Bragg to south of Bodega Bay and east to the east side of Clear Lake. The Pomo are composed of several culturally, but not politically, allied groups, speaking seven different languages (McLendon and Oswalt, 1978; Bean and Theodoratus, 1978; McLendon and Lowy, 1978). The seven languages have been classified as belonging to the Pomoan family, Hokan stock (Shipley, 1978).

Politically, the Pomoan people were organized by autonomous tribelets, each of which comprised a large village and several smaller villages. A tribelet was defined in terms of a known geographic area and was composed of an extended kin group. However, the kin group was considered to have been a more important social unit than the tribelet. Each village had a chief or headman who was elected or who inherited the position, depending on the group. Some larger villages had multiple chiefs.

Subsistence was based on hunting and gathering from a relatively stable or permanent village location. Various food resources were emphasized depending on the village's geographic location, but generally acorns were the staple. Other important food resources included buckeye, berries, seeds, roots, bulbs, seaweed and kelp, deer, elk, antelope, rabbits, squirrels, birds (some species were not eaten), bear, seal, sea lion, insects, and fish from lakes, streams, and the ocean.

The Pomo made exceptionally well-crafted basketry, tule boats, redwood bark structures, and a wide variety of bone, shell, and stone tools and ornaments.

Like many other California Native American groups, the Pomo had shamans who cured sickness and dispelled evil through the use of songs and sucking (i.e., sucking the disease object from the

afflicted). Much of Pomo life was influenced by a general fear of poisons. Care was taken in all aspects of daily life to avoid poisoning, and shamans were thought to have the ability to ward off illness, which was often thought to be caused by poison.

The Pomoan peoples' first contact with Europeans may have occurred as early as 1579 with the arrival of Sir Francis Drake. By the late 1700s, European trade goods were to be found throughout the region, and mission-convert raids occurred occasionally. From 1811 through 1825, Russians settled in Pomo territory. Relations with the Russians were good; substantial cultural influence often resulted from them and intermarriages occurred. In 1822, Mexican land grants were issued for Pomo areas, and the region was placed under military control.

Mission-convert raids intensified in 1823, disrupting Pomo society and reducing their population. A cholera or malaria epidemic in 1833 killed many individuals, and with slave raids between 1834 and 1847 and a smallpox epidemic in 1838, the Pomo population was greatly reduced. The influx of Euroamerican settlers, especially after 1850, resulted in massacres of Pomo and their placement on reservations in 1856. Because their land had been taken, those returning from the reservations at a later date were homeless. Although many became wage laborers, they continued to practice traditional lifeways.

For further information, also see the discussions for the Shasta, Wintu, and Wappo groups.

Central Coast Region

The Central Coast Region comprises San Benito County. The following sections describe the prehistory, history, and ethnography for this geographic region.

Prehistory of the Central Coast Region. Some evidence of human occupation of the Central Coast Region exists as early as 10,000 years ago. This date is derived from radiocarbon dating of organic material at a site in Santa Cruz County (SCr-177) (Moratto, 1984). Human activities at this early date, however, are not well represented in the archeological record, and little is known of the extent of occupation or the lifeways of these people.

Approximately 5,000 years ago, the area was inhabited by a group of generalized foragers who left behind evidence of a distinctive subsistence pattern. This archeological manifestation has been termed the Sur Pattern. The Sur Pattern is characterized by sites exhibiting a generalized use pattern, such as coastal middens with a wide range of faunal remains, and no evidence of food storage facilities. It has been suggested that these people were probably fairly mobile foragers, moving to exploit any available food resource (Moratto, 1984).

Approximately 2,500 years ago, the material culture of the area's occupants had changed. These archeological manifestations are called the Monterey Pattern. The people associated with this pattern are thought to have been collectors with specialized subsistence strategies. Archeologically, this pattern is seen in sites that are the result of specific uses or tasks. For example, coastal shell mounds have been found that appear to have been camps for shellfish processing, rather than villages. Additionally, Monterey Pattern sites often have food storage facilities, indicating prolonged use as residential bases.

It has been hypothesized that the people associated with the Sur Pattern (possibly ancestors of the Esselen) were replaced by the Monterey Pattern people (possibly ancestors of the Costanoans). This replacement of one pattern for the other, whether it represents an actual change in populations or not, has been documented through the stratigraphic identification of components displaying the features described above and chronologically placed with radiocarbon dates and artifact cross dating (Moratto, 1984).

The prehistory of the southern portion of this geographic area (San Luis Obispo County) is generally placed within the southern coast cultural chronology. Horizon I, or the Early Man Period Horizon, is poorly known but may have begun around 9000 B.C. and probably consisted of mobile hunter-gatherers. By around 7000 B.C., archeological data show evidence of fishing, intensive shellfish collecting, and hunting. Horizon II, the Milling Stone Horizon or Encinitas Tradition, is known from Diablo Canyon in San Luis Obispo County and is characterized by an extensive use of milling stones and a relative lack of projectile points after about 6500 B.C. (Moratto, 1984). Horizon III, the Intermediate Horizon or Campbell Tradition (after about 3000 B.C.), is defined by an increase in projectile points, greater reliance on land and sea mammals and shellfish (but not fish) for food, and an emphasis on mortars and pestles instead of manos and metates. Horizon IV, the late Prehistoric Horizon, is characterized by dense populations and cultural elaborations giving rise to ethnographically known peoples, such as the Chumash.

Prehistoric Resources—Central Coast Region. The following provides information on prehistoric resources from the Central Coast Region.

San Benito County. Approximately 203 sites have been recorded within San Benito County. Of these, 20 are historic sites or have historic components. Approximately 5 percent of the county has been surveyed for cultural resources. The overall degree of disturbance in San Benito County can be rated as low.

The prehistoric site types recorded within San Benito County are milling stations, lithic scatters, habitation sites, temporary camps, and rock shelter sites. Recorded sites are found in the highest density along the San Benito River and along the San Andreas Rift Zone.

History of the Central Coast Region. This geographic subregion of the study area is characterized by agricultural settlement and the establishment of communities along the coastline. The historical economy of the geographic subregion included agriculture, fisheries, energy-related industries, military installations, and tourism. Urban and suburban development has accelerated since the mid-1940s. Historic resources are related to the settlement of the subregion and include homesteads, economic/industrial facilities, residential properties, commercial establishments, and government facilities.

Historic-Period Resources—Central Coast Region. Table II-5 shows the number of resources listed in the NRHP, California Historic Landmarks, California Inventory of Historic Resources, and California Points of Historical Interest by county in the Central Coast Region. The resources described in the following section only include properties that are listed in these sources.

TABLE II-5

NUMBER OF HISTORIC RESOURCES IN THE CENTRAL COAST REGION

County	Number of Properties in the National Register of Historic Places	Number of California Historic Landmarks	Number of Sites in California Inventory of Historic Resources	Number of California Points of Historical Interest
San Benito	10	5	6	2

San Benito County. Historic resource themes found in San Benito County include architecture, economic/industrial, exploration/settlement, military, and religion. Ten properties are listed in the NRHP, five properties are California Historic Landmarks, and two properties are considered California Points of Historical Interest. The San Felipe Project is located in San Benito County. No listed historic resources are in the vicinity of the San Felipe Project.

CVP Facilities. No CVP facilities in this geographic subregion are considered historic resources.

Ethnographic Overview. The following discussion pertains to the Central Coast Region.

Costanoan. The Costanoans are a linguistically defined group composed of several autonomous triblets speaking eight different, but related, languages. The Costanoan languages, together with Miwok, compose the Utian language family of the Penutian stock (Levy, 1978a). The territory of the Costanoan people extended along the coast from San Francisco Bay in the north to just beyond Carmel in the south and approximately 60 miles inland. This territory encompasses a lengthy coastline and several inland valleys (Breschini et al., 1983). The primary sources for ethnographic information about the Costanoans are the Culture Element Distribution lists compiled by Harrington (1942). Other sources include notes of explorers, missionaries, and seafarers who came in contact with the Costanoans. Much of this information has been summarized by Levy (1978a).

The Costanoans were hunter-gatherers, relying heavily on acorns and coastal resources. However, a wide range of other foods was also exploited. These sources included various seeds (growth was promoted by controlled burning), buckeye, berries, roots, land and sea mammals, waterfowl, reptiles, and insects.

In 1770, the time of the establishment of the first mission in Costanoan territory, the population numbered an estimated 10,000, but it declined to less than 2,000 by 1832 because of introduced disease and a decreased birth rate (Levy, 1978a).

The Costanoans were politically organized according to tribelets, each tribelet having a designated territory. Marriages were polygymous, households were generally composed of patrilineally extended families, and clans and moieties were the basis for group identification.

In religion, prayers and offerings (e.g., to the sun) were practiced, as were shamanism and witchcraft. Dreams were interpreted and used as guides for future activities (Levy, 1978a). Tule balsas for watercraft, bows and arrows, cordage, sea otter blankets, and twined basketry were made (Levy, 1978a), as was the usual range of lithic and bone tools.

Esselen, Salinan, and Chumash. The Esselen are thought to have inhabited a mountainous territory along the south-central coast, south of Carmel, to around Point Lopez in the south and inland from about the upper Carmel River drainage to approximately Junipero Serra Peak in the south. However, these boundaries are approximate. The Esselen language has tentatively been placed within the Hokan stock, although this too is uncertain. In fact, almost nothing is known for certain about these people, and most of what is recorded comes from Costanoan informants. The few facts known about their language and territory are summarized by Hester (1978a, 1978b). The aboriginal way of life of the Esselen ended in 1770 with the establishment of Mission San Carlos Borromeo de Monterey.

The Salinan, occupying the territory to the south and east of the Esselen, extended from about Soledad in the northeast to approximately as far south as San Luis Obispo. These boundaries are not at all certain, however. The Salinan language has been tentatively placed within the Hokan stock and apparently included two dialects. The primary sources for ethnographic information on the Salinan are Mason (1912 and 1918) and Harrington (1942). These sources are summarized by Hester (1978b), which is the source of data for this synopsis.

The Salinan subsistence strategy apparently emphasized acorns but also used various seeds, fruits, deer, bears, and rabbits. Fishing was practiced by inhabitants of coastal areas and by interior groups (Hester, 1978b).

Because of the effects of mission life, the population declined to less than 700 individuals by 1831; by 1928, only 36 Salinans could be located.

Detailed ethnographic data about the Chumash groups are available. Explorers' journals, mission records, and archeology provide additional information. These sources are described in notes of J.P. Harrington (Hudson and Blackburn 1982; Hudson and Underhay 1978), Grant (1978a, 1978b, 1978c, 1978d) and Greenwood (1978). The Chumash are considered to have been one of the most elaborate cultures in California. Archeological evidence of Chumash culture is found in the remains of large villages with large populations, social ranking, intensive trade, craft specialization, and well-developed art styles (Moratto, 1984).

The Chumash inhabited the central coastal area of California from approximately San Luis Obispo in the north to Malibu Canyon in the south and inland as far as the west side of the San Joaquin Valley. They also lived on the Santa Barbara Channel islands. It is believed that at least six Chumashan languages existed and probably several dialects. The Chumashan languages have

been classified within the Chumashan language family, Hokan stock. All of the Chumashan languages are now extinct.

The Chumash were among the first California groups contacted by Europeans. In 1542, Cabrillo landed in Chumash territory and observed several Chumash villages. Several other explorers visited the area in the 1600s and 1700s, and, in 1772, the first mission within Chumash land was established at San Luis Obispo. By 1804, five missions were within Chumash territory and as early as 1800, all Chumash were either in the mission system or had fled inland. In 1831, 2,788 Chumash were registered at missions, a much smaller population than that originally reported by explorers or estimated by anthropologists (Kroeber, 1925). The decline in the population may have been caused by a combination of individuals escaping inland and widespread epidemic. By the late 1800s, after the mass arrival of Euroamericans, many of the surviving Chumash had become wage laborers.

San Francisco Bay Region

The San Francisco Bay Region consists of Alameda, Contra Costa, Marin, San Francisco, Santa Clara, and San Mateo counties.

Prehistoric Overview. The earliest known occupation of the San Francisco Bay area took place by approximately 8000 B.C., based on radiocarbon dates from a few locations in the south Bay Area. At present, insufficient information exists to determine the nature or extent of settlement during this early period.

Several radiocarbon dates from sites throughout the Bay Area indicate that populations of hunter-gatherers were sparse by approximately 5000 B.C., with settlements in the hill country and along the bay and ocean shores. This Archaic Period is characterized, like the Sur Pattern identified in the Monterey area, by generalized hunting and gathering subsistence. Midden deposits with a wide variety of faunal remains, including shell, but not shell mounds are typical of this period.

By approximately 2500 B.C., a distinctive culture tradition seems to have appeared in the east Bay Area (Contra Costa County). This has been called the Berkeley Pattern and is characterized by intensified and specialized collection of food resources, especially shellfish and acorns, and larger populations. The archeological evidence of this pattern is seen in large shell mound deposits along bay and marsh shores and a relatively greater quantity of ground stone than flaked stone. The Berkeley Pattern is distinguished from the Windmiller Pattern to the east (Sacramento-San Joaquin Delta area) by its greater amount of mortars and pestles, wide variety of bone and antler implements, distinctive flaking techniques, some forms of shell beads, and burial practices (Moratto, 1984). The Berkeley Pattern appears to have slowly spread, and evidence dating to 1500 B.C. has been identified in the south bay and the Napa Valley.

It has been hypothesized that the Berkeley Pattern "represents Utian (Miwok-Costanoan) cultural developments and geographic spread throughout the Bay and northern Central Coast regions. Old Berkeley Pattern components share many traits with those of the Windmiller Pattern, suggesting a common origin" (Moratto, 1984). This hypothesis tends to be supported by

archeological data from Alameda County in the east Bay Area. Site Ala-328 was apparently first occupied approximately 3,000 to 4,000 years ago, contemporaneous with other Berkeley Pattern sites. Excavation of this and other nearby sites suggests that, although some changes (e.g., in burial practices, stone use, and trade) occurred through time, the basic economic practices remained about the same. No evidence exists to support a claim of social or cultural replacement, and it has been concluded that there was continuous occupation of the area by Costanoan people (ethnographically known) for more than 2,000 years (Moratto, 1984).

Excavation of Site Ala-307 resulted in the identification of two strata, the earliest of which indicated a Windmiller Pattern or substantial influence from Windmiller people and the later of which was interpreted as having certain continuities with the earlier. If this interpretation is correct, then an evolution of Berkeley Pattern from Windmiller or Windmiller-like precursors may be postulated.

Historic Overview. This geographic subregion of the study area is characterized by urban and suburban development since the mid-1800s. The San Francisco Bay Area has been a major shipping, manufacturing, military, and commercial center for all of northern California since the 1860s. Historic/architectural resources are related to the settlement of the subregion and include economic/industrial facilities, residential properties, commercial establishments, military installations, and government facilities. Table II-6 shows the number of historic resources in the San Francisco Bay Region.

TABLE II-6

NUMBER OF HISTORIC RESOURCES IN THE SAN FRANCISCO BAY REGION

County	Number of Properties in the National Register of Historic Places	Number of California Historic Landmarks	Number of Sites in California Inventory of Historic Resources	Number of California Points of Historical Interest
Alameda	113	33	221	36
Contra Costa	25	12	108	10
Marin	33	13	30	4
San Mateo	39	34	75	34
San Francisco	121	43	141	12
Santa Clara	76	41	149	60

Ethnographic Overview. See the earlier discussion of Miwok and Costanoan culture.

RECENT CONDITIONS

The most significant change between the conditions before the CVP and after the CVP is the effect of large-scale agriculture on prehistoric archeological sites. Before the CVP, many large prehistoric mound sites remained largely intact despite surface impacts from agriculture and historical settlement. The development of the CVP opened areas to farming that previously had been considered either too dry or subject to periodic flooding. These conditions resulted in many prehistoric sites being leveled, plowed, or disked and planted.

Although not related to CVP activities, hydraulic mining during the gold rush resulted in many areas of California being affected by erosion and sedimentation. For example, in the Central Valley, sites have been found under many feet of sediment, suggesting that numerous resources may be buried under alluvial material. With the gold rush came miners and settlers, and the remnants of their activities have resulted in a plethora of historical sites.

Given the nature of the resources, little comparison can be made between pre-CVP and post-CVP historical and architectural resources. However, some CVP facilities, notably Shasta Lake, Folsom Lake, and New Melones Reservoir, have inundated some archeological and historical resources. Extensive inventory, evaluation, and mitigation efforts were completed for several CVP facilities, notably New Melones and San Luis reservoirs, but not at other facilities. Another aspect of the post-CVP existing conditions is that elements of the CVP have been found eligible for listing in the NRHP. Additional CVP components may have historical significance.

In the early part of the 20th century, Native Americans and their cultures were in a state of decline. Most groups were at the lowest population levels, and survival was their primary concern. Around the middle of this century, Native American traditional cultural practices underwent a revitalization that has continued until today. With this revitalization has come an increasing awareness of and concern for resources and sites that reflect the native heritage. An outgrowth of this concern has been the formal recognition of resources identified as having sacred value.

CHAPTER III

ENVIRONMENTAL CONSEQUENCES

Chapter III

ENVIRONMENTAL CONSEQUENCES

ANALYSIS METHODOLOGIES

The assessment of the impacts of the CVPIA alternatives on cultural resources focuses on those impact mechanisms that could result from implementing the CVPIA. This section describes these mechanisms and how they may affect cultural resources.

Figure 1-1 shows the PEIS study area, as well as the boundaries for the four regions included in this analysis (Sacramento River Region, Sacramento-San Joaquin Delta Region, San Joaquin River Region, and Tulare Lake Region). The information in Chapter II, "Affected Environment," is presented using somewhat different geographic divisions because historic information regarding cultural resources is collected by county, and the regional boundaries do not always correspond to county boundaries.

IMPACT MECHANISMS

The following impact mechanisms have been identified as potentially affecting cultural resources: changes in reservoir operations, streamflows, land use and agricultural practices, water delivery amounts to refuges, and habitat restoration associated with anadromous fisheries.

Mechanisms Related to Reservoir Operations

Changes in reservoir operations could affect cultural resources at reservoir margins by changing historical patterns of reservoir filling and emptying and by changing flows (and therefore stages) in rivers and streams downstream of the reservoir. Implementing Alternatives 1 through 4 would not result in changes to reservoir operations related to flood control; therefore, no changes in flooding patterns downstream of these reservoirs are expected, and inundation of cultural resources adjacent to rivers is not expected as a result of implementing the CVPIA.

Changes in Reservoir Margins. Cultural resources located in the drawdown zone of reservoirs are most susceptible to damage from hydrologic changes. The most damaging impacts would probably be caused by erosion. Of particular concern are sites located in wave zones created either by wind or by boat traffic. Boat-caused waves can be very destructive to cultural resources, especially on smaller reservoirs (Lenihan et al., 1981). This is especially true if natural vegetation, which could help anchor soil, is no longer present. Some erosion occurs from rising and falling waters across the resources during times of reservoir drawdown (Lenihan et al., 1981).

Less obvious, but also potentially destructive to resources, is wet/dry cycling. Wet/dry cycling is caused by the repeated inundation and exposure of resources, which causes perishable items (e.g., bone, wood, shell, ceramics, pollen, and leather) to disintegrate rapidly.

Another impact tied to the exposure of resources during drawdowns is damage caused by animals. For example, at Folsom Lake, site CA-Eld-204 had soils containing cultural remains (referred to as middens); exposure of the site during a drought revealed that the burrowing actions of the introduced clam *Corbicula fluminea* caused a major impact on this site. Further damage was caused by raccoons that dug into the exposed midden in hunt of the clams (Lenihan et al., 1981). Lenihan et al. (1981) also noted the destruction of site features caused by cattle walking on sites still soft from having been recently exposed.

Changes in Recreation. Vandalism, whether caused by organized artifact collectors or by inadvertent disturbance, is a constant threat to the public's cultural resources. As the number of recreationists at facilities increases (because of better boating, swimming, or fishing opportunities), cultural resources are at greater risk. These risks are present not only at sites that are exposed at water margins, but also in the zone above inundation. For example, several sites have been recorded in the floodplain of the American River below Folsom Lake. Improved fishing could attract more anglers who would walk through this area to reach the river, which could lead to the discovery and possible looting of cultural resources. An increase in vandalism was recorded during the filling of Lake Shasta. An historic site that was formerly reached by an arduous 6-mile hike was exposed to greater vandalism when it became a 10-minute hike from the new lake margin (Lenihan et al., 1981; Henn and Sandohl, 1986).

Cultural resources can also be at risk during times of lower water levels, even though fewer recreationists would be expected, especially at reservoirs. Drawdowns can expose sites, many of which may become visible to artifact collectors because inundation has removed vegetative cover. Drawdowns often leave a fine silt bench where the water has receded. The type of landform created when reservoirs are drawn down is a favorite of off-highway vehicle (OHV) users, who may unknowingly destroy cultural resources by using these areas (Lenihan et al., 1981).

Increased numbers of recreationists at CVP facilities (expected when water levels are higher) may require construction of new recreational facilities that may, in turn, affect cultural resources. Impacts could occur from construction of new roads, restrooms, parking lots, marinas, and boat ramps. Lowering water levels could also require new construction to extend boat ramps, create new beaches, or relocate marinas.

Impacts due to changes in recreation use at wildlife refuges are discussed under Mechanisms Related to Increased Water Deliveries to Refuges in a subsequent section.

Mechanisms Related to Changes in Streamflows

Changes in streamflows can cause impacts on cultural resources by changing recreational use. The types of impacts caused by increased recreational use are discussed in the preceding section under "Changes in Recreation."

Mechanisms Related to Changes in Land Use and Agricultural Practices

Changes in Crops. Agricultural practices associated with various types of crops can lead to lesser or greater impacts on cultural resources. For instance, planting rice (where it is necessary to recontour the landscape) or planting orchards (where it is necessary to plow the land to a depth of approximately 2 meters) can be very destructive to cultural resources. Changes in agricultural patterns that encourage planting pasture or grains, which involve minimal ground disturbance, would be beneficial to the preservation of cultural resources.

Fallowing and Retirement of Land. Under Alternatives 1 through 4, farmland irrigated with CVP water would be retired because of drainage problems. In addition, in Alternatives 2 through 4 other land would be fallowed through purchases of water to meet AFRP (Anadromous Fish Restoration Program) river flows. The removal of lands from agricultural production would benefit cultural resources.

Terrestrial Habitat Restoration. Some lands that would be fallowed also could be restored for terrestrial habitat. Restoration of fallowed lands is proposed only under Alternatives 3 and 4. Restoration activities would involve fairly low-impact activities such as leveling furrows, spreading grass seeds, and planting small trees.

The analysis assumes that all retired land would be restored. Two scenarios are being considered to restore retired lands. Scenario 1 would involve land retirement with very minor amounts of vegetative planting to reduce soil erosion. This scenario would involve minimal potential disturbance to cultural resources. Scenario 2 would involve restoring oak woodland and riparian habitat in areas where land is retired. Ground disturbance associated with Scenario 2 also has a low potential to affect cultural resources because these activities are expected to cause equal or less disturbance to the land than the existing farming practices. Both scenarios could be implemented under any of the alternatives.

Mechanisms Related to Increased Water Deliveries to Refuges

Under certain provisions of the CVPIA, existing wildlife refuges would receive additional water. Cultural resources are likely to be present along the margins of historical wetlands within these refuges. Although it is likely that the additional water would be used to flood existing areas for longer periods during the year, new areas could be flooded as part of this process. Areas that would be newly flooded would largely be restricted to areas of historical wetlands. Nevertheless, cultural resources could be affected by increased water deliveries to refuges and by restoration of habitat at existing refuges. Impacts on cultural resources from vandalism could also occur from the increased recreation that would likely result from increased water deliveries to refuges.

Mechanisms Related to Fish Habitat Restoration Activities

Cultural resources could be damaged by the fish habitat restoration activities included in all of the alternatives. Most of the measures being considered to help promote survival of young anadromous fish could affect cultural resources in two ways: through ground-disturbing activities where cultural resources are located and through increased recreation. Tables III-2,

III-3, and III-4 in the Fisheries Technical Appendix show the fisheries restoration activities that would occur under Alternatives 1 through 4.

Installing fish screens, relocating diversions, creating escape channels, replenishing gravel beds, restoring spawning grounds, constructing pumping plants, revegetating watercourse banks, and dredging are all fish restoration actions that could affect cultural resources through ground disturbance. Of special concern are dredging activities that could disturb shipwrecks.

The removal or modification of dams to remove barriers to fish passage could affect cultural resources if the dams are of historical importance. In addition, the removal of dams could result in ground disturbance affecting resources in the vicinity or could result in possible site exposure.

CULTURAL RESOURCE TYPES

The following sections describe how different types of cultural resources may be affected by the impact mechanisms discussed in the previous section.

Prehistoric Site Types

Of the various types of prehistoric sites that may be affected by the CVPIA alternatives, habitation sites, especially those sites containing midden soils, are most susceptible to damage. Generally the scientific value of habitation sites lies in the information on prehistoric life ways that can be extracted. Any activity that moves, removes, or destroys aspects of a site will compromise that information. Soils containing middens tend to be loose and easily eroded by wave action or the movement of water across a site. Midden soils often retain identifiable remnants of faunal material (e.g., bone or shell), possibly human burials, and occasionally perishable artifacts (e.g., basketry remains) that, if exposed, would deteriorate due to wet/dry cycling. Habitation sites are highly susceptible to intentional vandalism by artifact collectors and unintentional damage by OHV users.

Another site type commonly found in the CVPIA study area are lithic scatters (strictly defined as those sites that contain only material manufactured from stone). The greatest danger to these sites is from artifact collection. If artifacts are moved from their original location by rising or falling waters, information about the site will be lost. Further, erosional forces could remove artifacts from a site, and the submersion of obsidian artifacts could prevent the proper dating of objects by hydration-dating techniques.

Rock art sites containing petroglyphs, pictographs, and intaglios (artistic alignments of rocks) can be extremely vulnerable to changes in water level. Sites that may have been previously submerged under reservoirs and are exposed during drawdowns may suffer from wet/dry cycling, erosion due to wave action, and vandalism.

Bedrock mortars (used for grinding vegetal materials) are the prehistoric resource type least susceptible to damage through hydrologic mechanisms. However, midden, often associated with bedrock mortars, would be vulnerable to hydrologic impacts.

Historic Site Types

Historic resources (including archeological resources, structures, and buildings) within the CVPIA study area include sites associated with early historic settlement, mining (hardrock and placer), agriculture (farming and ranching), transportation (railroads and roads), oil exploration, and logging.

Historic structures (including buildings, windmills, mining winches, and bridges) or their remains are highly susceptible to water level changes. The exposure of structures in reservoirs previously covered by inundation could subject them to erosion (especially if they are in a wave zone), wet/dry cycling, and vandalism.

Wooden portions of ditches and flumes (often associated with agriculture, mining, and logging) are highly susceptible to wet/dry cycling and erosion. Earthen ditches are affected principally by water level changes, especially wave action.

Debris scatters, which can be found within any type of historic site, are extremely vulnerable to water level changes. Erosion can completely remove a debris scatter, and wet/dry cycling can accelerate the decomposition of metal, wood, and leather artifacts. Debris scatter exposed by receding waters is very susceptible to vandalism.

Historic stone resources such as tailings piles (remnants from mining) and rock walls (often associated with ranching) are less prone to water damage unless these resources are left in a wave zone by changing water levels.

Traditional Cultural Properties

Traditional cultural properties (TCPs) are properties that are identified as significant to an identifiable social group. The properties can be important because of cultural practices or beliefs, and are difficult to identify because often only members of the group are allowed to know their locations.

Common TCPs include geographic features such as prominent boulders or springs (locations where people traditionally gathered), harvesting locations (where plant food and medicinal and basketry materials were traditionally gathered), and large geographic features. Changes in hydrology and recreational use associated with the alternatives could disrupt the use of TCPs. Hydrologic damage could occur through inundation or erosion. Increased recreational use is likely to bring vandalism (i.e., graffiti on a sacred boulder) and the disturbance of ceremonial practices at TCP locations by visitors.

DATA ANALYSIS

Hydrology

The impact assessment for reservoirs includes both hydrologic and recreation-related mechanisms that could result from changing reservoir operations. This analysis used information extracted from the PROSIM and SANJASM hydrologic models on month-end reservoir

elevations over the 69-year simulation period. Information for the entire 69-year period and for representative wet and dry year-types was available to assess when and how often reservoir margins would be exposed. Because site location information is not available for most of the reservoirs in the study area, the impacts of erosion, wet/dry cycling, and animal-related effects were not directly assessed. Instead, the highest and lowest elevations during the 69-year hydrologic period for each reservoir (under each alternative, including the No-Action Alternative) were extracted from the hydrologic data. These were used to suggest locations where the greatest likelihood of impact from hydrologic fluctuations would be expected and where existing historic and prehistoric sites previously unaffected by reservoir operation could be affected by higher reservoir levels. Low lake levels were used in assessing the impacts that could result from increased opportunity for vandalism, as described in a following section.

The analysis presented in this TA is based on numerical results from surface water modeling efforts. The modeling efforts were primarily developed to meet streamflow target goals. The CVP and SWP reservoirs were reoperated within the model (to the extent possible with monthly models) to meet downstream flow targets. Modified operating rules were developed for the CVP and the SWP reservoirs in Alternatives 1 through 4. The projected monthly changes in reservoir storages reflect these estimated modifications in reservoir operations and can be used on a comparative basis between the alternatives and the No-Action Alternative.

Operation of Whiskeytown and Englebright lakes, Lake Red Bluff, Lake Natoma, Thermalito Forebay and Afterbay, and New Bullards Bar and Camp Far West reservoirs is not expected to change under Alternatives 1 through 4 relative to the No-Action Alternative; therefore, no further analysis of these facilities has been undertaken.

The non-CVP and non-SWP reservoirs included in this analysis are Camanche Reservoir, Lake McClure, New Don Pedro Reservoir, and New Hogan Lake. The non-CVP and non-SWP rivers are the Tuolumne River and the Merced River. The hydrologic modeling conducted for this analysis has not included reoperation of non-CVP and non-SWP reservoirs. The operational scenarios for these reservoirs are based on their historical operations. No attempt has been made to optimize operations, and actual operations could differ from these assumptions. Therefore, the analysis of these reservoirs and the rivers they control is presented at a more general level of detail than the analysis of the CVP and SWP facilities. Further, should water be purchased from these reservoirs, information on the price of water would be required to include mitigation for adverse impacts that could not be overcome through reoperation; therefore, effects rather than impacts are described for these facilities.

Due to model limitations, differences in reservoir maximums and minimums of less than 10 feet, between Alternatives 1 through 4 and the No-Action Alternative, were assumed not to result in impacts.

Recreation

Estimates of the average number of visitor days spent annually at each reservoir under the No-Action Alternative and Alternatives 1 through 4 were obtained from the recreation analysis. These data were generated based on the assumption that recreational use at reservoirs will increase when more water is available at the reservoirs, except when facilities (beaches, boat

ramps) are submerged. It should be noted that the recreational use numbers do not differentiate between boaters and terrestrial users. However, this analysis is based on the assumption that when more visitors are present at a reservoir, a greater potential for vandalism to sites above the waterline exists, regardless of the type of use.

Recreational use often decreases when reservoirs are drawn down; however, it is not possible to conclude that cultural resources are safe from vandalism when use numbers decrease. Motivated artifact collectors may choose to operate when recreational use decreases and fewer people will witness them. Lower water could also provide open landforms commonly preferred by OHV enthusiasts, and their use could result in site damage.

As discussed in the section "Impact Mechanisms Related to Streamflow Changes," changes in streamflows could result in an increased potential for vandalism associated with increases in recreation. In the following analysis, it is assumed that higher numbers of visitors would present increased opportunities for vandalism to occur.

Estimates of recreational use for rivers in the San Joaquin River Region under each alternative are based on the relationship between increases in streamflows and increases in visitor use days. This makes quantitative analysis possible. Conversely, estimates of recreational use for rivers in the Sacramento River Region and the Sacramento-San Joaquin Delta Region are based on changes in fishing opportunities resulting from increases in anadromous fish populations. Because fish population estimates associated with each alternative are not being prepared for this EIS, the cultural resources analysis for the impacts of recreation on these rivers and streams is presented only qualitatively.

Recreation data for all streams in the CVPIA study area are separately categorized either as numbers of visitors who are fishing or visitors who are participating in nonconsumptive activities. For the cultural resources analysis, however, these data are combined because the analysis is not sensitive to individual recreational uses.

Where recreational use was determined to change by more than 5 percent compared to that of the No-Action Alternative, an adverse impact or effect on cultural resources is assumed to occur. Similarly, a decrease in recreational use of more than 5 percent compared to the No-Action Alternative is assumed to result in a beneficial impact or effect.

Changes in Land Use and Terrestrial Restoration

Figures III-8, III-9, III-10, and III-11 in the Vegetation and Wildlife Technical Appendix show the changes in acreage for key crop types expected to occur under each of the action alternatives compared to the No-Action Alternative. These figures also show the amount of land that would be fallowed and the number of acres that would be retired under each alternative. This analysis focuses on those crop types (such as orchards and rice) that have a high potential to affect cultural resources.

Some fallowed land would also be restored for terrestrial habitat under Alternatives 3 and 4. As described in the Vegetation and Wildlife Technical Appendix, 15 percent of fallowed land would be restored under Alternatives 3 and 4.

Data on the amount of retired land estimated to be restored as wildlife habitat were also obtained from the wildlife analysis contained in the Vegetation and Wildlife Technical Appendix.

Increased Water Deliveries to Refuges

The impact assessment related to increases in water deliveries to refuges is based on differences between baseline, Level 2, and Level 4 water supplies. Changes in average annual refuge recreational use under the No-Action Alternative and Alternatives 1 through 4 were obtained from the recreation analysis to assess impacts from increased visitation. Under the No-Action Alternative, refuges would continue to receive existing levels of water supply. Under Alternative 1, with some minor exceptions described in the Vegetation and Wildlife Technical Appendix, all refuges would receive Level 2 water deliveries. Under Alternatives 2 through 4, the refuges are assumed to receive Level 4 amounts.

Anadromous Fisheries Habitat Restoration

The impact assessment of anadromous fisheries habitat restoration actions along streamcourses is based on the list of restoration activities shown in Tables III-2, III-3, and III-4 in the Fisheries Technical Appendix. Because these restoration activities are still in the planning phase, their locations and potential to cause impacts on cultural resources from ground disturbance are not yet known. Therefore, these impacts are discussed only in general terms.

Section 106 Compliance Process

It is assumed that prior to any CVPIA undertaking the lead federal agency will comply with Section 106 of the National Historic Preservation Act (NHPA), which requires federal agencies to take into account the effect of an undertaking on historic properties before implementation.

NO-ACTION ALTERNATIVE

Reclamation or the Service will be responsible for the individual undertakings required to implement the CVPIA. It is likely that cultural resources research for each undertaking will need to meet federal standards. Standards and guidelines on archeology and historic preservation are provided by the National Park Service (1983) to ensure the adequacy of work conducted in compliance with Section 106 of the NHPA. The following description of the steps necessary to comply with Section 106 is consistent with these directives.

For each undertaking, an APE will be established. The APE is the geographical area or areas within which an undertaking may cause changes in the character or use of a historic property (i.e., a property that is eligible for the NRHP). After establishment of the APE, a records search at the appropriate Information Center of the California Historical Resources File system will be conducted to determine whether the APE had been previously surveyed and cultural resources had been previously identified.

Based on information obtained from the records search, an assessment will be made of the status of each undertaking in terms of remaining cultural resources management needs. The amount of

previous research will be an important factor when determining what actions are necessary to mitigate the effects of implementing the CVPIA in compliance with Section 106 of the NHPA. This is because many of the CVPIA reservoirs have been previously subjected to extensive cultural resources inventory efforts and extensive cultural resources mitigation work was conducted prior to filling some reservoirs. At other facilities, little or no inventory and mitigation was conducted prior to construction. Previous cultural resources management investigations will be evaluated according to how well they meet the historic preservation requirements for the undertakings necessary to implement the CVPIA.

To determine what work would need to be conducted at CVPIA reservoirs, planning and reservoir management documents will also be reviewed. Many of these documents include strategies for addressing impacts that could occur from implementation of the CVPIA because many of the impacts that have been identified are ongoing conditions.

Identification, evaluation, and treatment efforts, mandated in the implementing regulations of Section 106 of the NHPA (36 CFR 800), will be undertaken. The basic elements of these tasks are described in the following section, although the actual work for each undertaking could vary depending on direction from the lead federal agency.

Following an assessment of previous inventory and mitigation efforts within the APE, the lead federal agency will recommend, in consultation with the SHPO, any inventory efforts necessary to identify, relocate, or assess the current condition of resources necessary to comply with Section 106. Such consideration at the federal level requires that historic properties be identified in a manner consistent with the standards set by the Reclamation Manual, the Service Administrative Manual, and the Service Cultural Resource Management Handbook (1985). Standards and guidelines provided by the National Park Service (1983) outline the tasks involved in performing identification: research design, archival research, and field survey.

A research design will be prepared, where deemed appropriate by the lead federal agency, to guide identification efforts for implementation of the CVPIA. The National Park Service (1983) specifies that identification activities are essentially research activities for which a statement of objectives or research design should be prepared before work is performed. Within the framework of a comprehensive planning process, the research design provides a vehicle for integrating the various activities performed during the identification process and for linking those activities directly to the goals and the historic context(s) for which those goals were defined. The research design stipulates the logical integration of historic context(s) and field and laboratory methodology.

Where deemed appropriate by the lead federal agency, archival research will be conducted to identify resources that could be affected by implementation of the CVPIA. The National Park Service (1983) specifies that archival research should address specific issues and topics. Sources should include, but not be limited to, historical maps, atlases, tax records, photographs, ethnographies, folklife documentation, oral histories, and other studies, as well as standard historical reference works, as appropriate for the research problem. Archival/background research is particularly important for the identification and evaluation efforts of historic resources.

Where necessary, the lead federal agency will conduct surveys to identify resources that could be affected by implementation of the CVPIA. The National Park Service (1983) identifies two strategies for conducting a field survey reflecting varying levels of effort responsive to management needs and preservation goals. A reconnaissance survey, where only sample areas are examined, is considered useful for gathering estimates of types and numbers of properties present. An intensive survey, consisting of complete examination of the entire project area, is considered necessary for determining precisely what historic properties exist in a given area. The federal guidelines suggest that intensive survey should document the kinds of properties looked for; the boundaries of the area surveyed; the method of survey; a record of the precise location of all properties identified; and information on the appearance, significance, integrity, and boundaries of each property sufficient to permit an evaluation of its significance. A field survey is often followed by a site-testing phase to collect sufficient information for NRHP evaluation.

If resources are identified in the APE that will be affected by implementation of the CVPIA, the lead federal agency will evaluate them to determine whether they are eligible for listing in the NRHP. Evaluation is the process of determining whether identified properties meet one or more of four defined criteria of significance, focusing on historical, architectural, archeological, engineering, and cultural values, as specified by 36 CFR 60.4. The National Register Bulletin 15, put forth by the National Park Service (1983), provides technical information on how to apply the National Register criteria for evaluation. An evaluation report should outline the disciplines or broad areas of concern included within the scope of the inventory; explain what kinds of properties, if any, are excluded and the reasons for exclusion; and define how levels of significance are measured, if such levels are incorporated into the criteria. The information needed for evaluating properties includes adequately developed historical contexts and sufficient information about the appearance, condition, and associative values of the property (e.g., classification of property type, comparison of its features or characteristics with those expected for its property type, and definition of the location and physical extent of the property).

The lead federal agency will ensure that NRHP-eligible resources affected by implementation of the CVPIA will be treated. Treatments of historic properties include a variety of techniques to preserve or protect properties, or to document their historic values and information. In the case of unavoidable adverse effects on historic or prehistoric archeological sites, data recovery programs are usually implemented. Preservation, rehabilitation, restoration, and stabilization are common treatments for architectural properties.

IMPACT MECHANISMS RELATED TO RESERVOIR OPERATIONS

Sacramento River Region

Under the No-Action Alternative, Shasta Lake's high water level would be 1,067 feet, the low water level would be 902 feet, and the annual visitor use days would be 5,740,000. The high water level at Lake Oroville would be 900 feet, the low water level would be 652 feet, and annual visitor use days would be 1,250,000. The high water level at Folsom Lake would be 462 feet, the low water level would be 331 feet, and annual visitor use days would be 910,000.

San Joaquin River Region

Under the No-Action Alternative, the high water level for Millerton Lake would be 578 feet, the low water level would be 464 feet, and the annual number of visitors would be 663,000. For New Melones Reservoir, the high water level would be 1,086 feet, the low water level would be 841 feet, and the annual number of visitors would be 800,000. For San Luis Reservoir, the high water level would be 543 feet, the low water level would be 337 feet, and the annual number of visitors would be 184,000. For Camanche Reservoir, the high water level would be 237 feet, the low water level would be 125 feet, and the annual number of visitors would be 318,000. For New Don Pedro Reservoir, the high water level would be 830 feet, the low water level would be 583 feet, and the annual number of visitors would be 422,000. For Lake McClure, the high water level would be 866 feet, the low water level would be 583 feet, and the annual number of visitors would be 842,000. For New Hogan Lake, the high water level would be 700 feet, the low water level would be 579 feet; and the annual number of visitors would be 217,000.

RECREATIONAL USE RELATED TO STREAMFLOWS

Sacramento River Region

Under the No-Action Alternative, annual visitor use days on the upper Sacramento River would be 26,000; on the lower Sacramento River, 195,000; on the Feather River, 103,000; on the American River, 99,000; and on the Yuba River, 34,000.

Sacramento-San Joaquin Delta Region

The annual number of visitors to the Sacramento-San Joaquin Delta under the No-Action Alternative would be 262,000.

San Joaquin River Region

The annual number of visitors to the San Joaquin River under the No-Action Alternative would be 520,000. The annual number of visitors to the Stanislaus River under the No-Action Alternative would be 283,000. The annual number of visitors to the Tuolumne River under the No-Action Alternative would be 203,000. The annual number of visitors to the Merced River under the No-Action Alternative would be 187,000.

LAND USE CHANGES

Sacramento River Region

Under the No-Action Alternative, no agricultural land would be fallowed or retired through actions of Reclamation or other federal agencies. Approximately 392,500 acres of orchard and 472,300 acres of rice would be under production.

Sacramento-San Joaquin Delta Region

Under the No-Action Alternative, no agricultural land would be fallowed or retired through actions of Reclamation or other federal agencies. Approximately 33,800 acres of orchard and 2,000 acres of rice would be under production.

San Joaquin River Region

Under the No-Action Alternative, no CVP land would be fallowed or retired through actions of Reclamation or other federal agencies. Approximately 801,200 acres of orchard and 13,400 acres of rice would be under production.

Tulare Lake Region

Under the No-Action Alternative, no land would be fallowed or retired through actions of Reclamation or other federal agencies. Approximately 629,500 acres of orchard and 100 acres of rice would be under production.

WATER DELIVERIES TO REFUGES

Under the No-Action Alternative, CVP water deliveries to Sacramento Valley refuges would total approximately 128,000 acre-feet. No refuges in the Sacramento-San Joaquin Delta Region are within the scope of this analysis. Water deliveries to the San Joaquin Valley refuges and private wetlands would total approximately 143,570 acre-feet of CVP water. Water deliveries to the Tulare Basin refuges would total approximately 28,450 acre-feet of CVP water

ALTERNATIVE 1

All impacts and mitigation measures are described under Alternative 1. Where the same impact and mitigation measure would apply under Alternative 2, 3, or 4, however, the reader is referred back to the description under Alternative 1 to avoid repetition.

IMPACT MECHANISMS RELATED TO RESERVOIR OPERATIONS

Sacramento River Region

Shasta Lake. Under Alternative 1, the high and low water levels would be the same as under the No-Action Alternative. No impact on cultural resources would occur.

Under Alternative 1, annual visitor use days at Shasta Lake would decrease less than 2 percent from the annual use estimated for the No-Action Alternative. This amount of change would not likely have an impact on cultural resources.

Lake Oroville. Under Alternative 1, Lake Oroville's high water level would remain constant and the low water level would be 5 feet lower than under the No-Action Alternative. This amount of fluctuation would not have an impact on cultural resources.

Under Alternative 1, annual visitor use days at Lake Oroville would increase by less than 1 percent from the annual use estimated for the No-Action Alternative. This increase in recreational use would not have an impact on cultural resources.

Folsom Lake. Under Alternative 1, the high water level at Folsom Lake would be the same as under the No-Action Alternative, and the low water level would be 5 feet higher than under the No-Action Alternative. This amount of fluctuation would not have an impact on cultural resources.

Under Alternative 1, annual visitor use days at Folsom Lake would increase by less than 2 percent from the annual use estimated for the No-Action Alternative. This amount of change would not have an impact on cultural resources.

San Joaquin River Region

The non-CVP and non-SWP reservoirs included in this analysis are Camanche Reservoir, Lake McClure, New Don Pedro Reservoir, and New Hogan Lake. The non-CVP and non-SWP rivers are the Tuolumne River and the Merced River. The hydrologic modeling conducted for this analysis has not included reoperation of non-CVP and non-SWP reservoirs. For more information, see the discussion under "Analysis Methodologies."

Millerton Lake. Under Alternative 1, the high and low water levels and annual visitor use days at Millerton Lake would remain the same as under the No-Action Alternative. No impact on cultural resources would occur.

New Melones Reservoir. Under Alternative 1, New Melones Reservoir's high water level would remain the same as under the No-Action Alternative; however, the low water level would be 123 feet lower than under the No-Action Alternative. Resources could be exposed to vandalism during periods when the reservoir is drawn down to these levels. New Melones Reservoir was subject to an extensive program of inventory, evaluation, and mitigation before it was filled. This program information should be consulted at the beginning of any Section 106 process related to changes in reservoir operations.

Under Alternative 1, annual visitor use days at New Melones Reservoir are expected to decrease less than 2 percent from the annual use estimated for the No-Action Alternative. This small change would not have an impact on cultural resources.

San Luis Reservoir. Under Alternative 1, the high water level at San Luis Reservoir would remain the same as under the No-Action Alternative. The low water level would be 5 feet higher than under the No-Action Alternative. The reservoir level changes that would result from implementing Alternative 1 would not have an impact on cultural resources.

Under Alternative 1, annual visitor use days at San Luis Reservoir are expected to increase less than 1 percent from the annual use estimated for the No-Action Alternative. This amount of change in recreational use would not have an impact on cultural resources.

Non-CVP and Non-SWP Reservoirs. Under Alternative 1, the high water levels would remain the same and the low water levels would vary up to 14 feet lower than levels under the No-Action Alternative. Resources could be exposed to vandalism during periods when a reservoir is drawn down to these levels.

Under Alternative 1, annual visitor use days would decrease less than 1 percent. This amount of change would not result in impacts on cultural resources.

IMPACT MECHANISMS RELATED TO STREAMFLOW CHANGES

Sacramento River Region

Changes in recreational use of rivers and streams in the Sacramento River Region were estimated in the Recreation Technical Appendix based on changes in the abundance of anadromous fish. Because fish population projections for each alternative have not been made, the impacts of increased recreation on cultural resources along the Sacramento, Feather, American, and Yuba rivers are not analyzed in detail. Generally speaking, recreation opportunities at these rivers would increase as a result of improvements to anadromous fisheries under Alternative 1. Estimates of increases in recreational use based on a range of possible increases in anadromous fish populations are presented in Attachment A of the Recreation Technical Appendix. These estimates are provided for illustrative purposes only; the effects of Alternative 1 on recreational use at Sacramento River Region rivers cannot be determined.

Sacramento-San Joaquin Delta Region

Changes in recreational use of rivers and streams in the Sacramento-San Joaquin Delta Region would be related to changes in the abundance of anadromous fish. See the discussion in Impact Mechanisms Related to Streamflow Changes, under Sacramento River Region.

San Joaquin River Region

Changes in recreational use of rivers in the San Joaquin River Region were estimated in the Recreation Technical Appendix based on changes in streamflows, so an assessment of effects on cultural resources is provided below.

San Joaquin River. Under Alternative 1, the annual number of visitors to the San Joaquin River will decrease by less than 1 percent compared with the No-Action Alternative. This amount of change will not have an impact on cultural resources.

Stanislaus River. Under Alternative 1, the annual number of visitors to the Stanislaus River will increase by less than 1 percent compared with the No-Action Alternative. This amount of change will not have an impact on cultural resources.

Non-CVP and Non-SWP Rivers. Under Alternative 1, the annual number of visitors will decrease by less than 1 percent compared with the No-Action Alternative. This amount of change will not have an impact on cultural resources.

IMPACT MECHANISMS RELATED TO LAND USE CHANGES

Sacramento River Region

Under Alternative 1, approximately 1,600 acres of agricultural land in the Sacramento River Region would be fallowed. No land would be retired in this region. The number of acres in orchards would remain the same as under the No-Action Alternative and the number of acres under rice production would decrease by 200 acres. This minimal amount of change in land use would not have an impact on cultural resources.

Sacramento-San Joaquin Delta Region

Under Alternative 1, no agricultural land would be fallowed in the Sacramento-San Joaquin Delta Region. No land in this region would be retired. The number of acres of orchards and rice under production would be the same as under the No-Action Alternative. No impacts on cultural resources would occur.

San Joaquin River Region

Under Alternative 1, approximately 10,000 acres of agricultural land would be fallowed and 14,400 acres would be retired in the San Joaquin River Region. Orchard production would be reduced by 200 acres and rice production would be reduced by 100 acres. This amount of change would result in a very minimal benefit to cultural resources.

Tulare Lake Region

Under Alternative 1, approximately 6,400 acres of agricultural land would be fallowed and 15,600 acres would be retired in the Tulare Lake Region. The number of acres of orchard under production would be reduced by 200, and the acreage of rice would remain the same. This amount of change could result in a very minimal benefit to cultural resources.

IMPACT MECHANISMS RELATED TO TERRESTRIAL HABITAT RESTORATION

Sacramento River Region

No terrestrial habitat restoration is planned on the land fallowed in the Sacramento River Region under Alternative 1 and no land would be retired. No impacts on cultural resources would occur.

Sacramento-San Joaquin Delta Region

No terrestrial habitat restoration is planned on the land fallowed in the Sacramento-San Joaquin Delta Region under Alternative 1 and no land would be retired. No impacts on cultural resources would occur.

San Joaquin River Region

Under Alternative 1, none of the land fallowed in the San Joaquin River Region would be restored, but all 14,400 acres proposed for retirement would be naturally reseeded as annual grasslands. This reseeding has very low potential to affect cultural resources because little or no ground disturbance would be required.

Tulare Lake Region

Under Alternative 1, none of the land fallowed in the Tulare Lake Region would be restored, but all 15,600 acres proposed for retirement would be naturally reseeded as annual grasslands. As described for the San Joaquin River Region, this restoration would have a very low potential to affect cultural resources.

IMPACT MECHANISMS RELATED TO INCREASED WATER DELIVERIES TO REFUGES

All refuges would receive Level 2 water, resulting in the delivery of more water than under the No-Action Alternative. Deliveries to the Sacramento River Region refuges would increase 18 percent, deliveries to the San Joaquin River refuges would increase 65 percent, and deliveries to the Tulare Lake Region refuges would increase 36 percent. Reduced deliveries to refuges would be possible during dry years. Deliveries to refuges would be reduced by the same percentage as reductions for other users receiving water from the same sources.

Cultural resources in the areas receiving additional water could be affected by flooding or increased erosion. Under Alternative 1, Level 2 water would be supplied to all refuges. Recreational use would increase in the Sacramento and San Joaquin River Region refuges above the level described under the No-Action Alternative. Recreational use in the Sacramento River Region would increase by an estimated 24 percent and recreational use in the San Joaquin River Region would increase by an estimated 28 percent. This additional visitation would increase the potential for sites to be vandalized. In the Tulare Lake Region, recreational use would remain the same as described under the No-Action Alternative.

IMPACT MECHANISMS RELATED TO ANADROMOUS FISHERIES HABITAT RESTORATION

Some of the projects currently proposed to improve anadromous fisheries habitat under Alternative 1 include considerable ground disturbance and are likely to affect cultural resources. Many of the projects are proposed to occur in areas that have a high probability of containing cultural resources. These projects would occur in all study regions except the Tulare Lake Region. Direct impacts on cultural resources could result from the effects of constructing and operating new facilities and modifying existing facilities. Tables III-2, III-3, and III-4 in the Fisheries Technical Appendix show the fisheries restoration activities that would occur under Alternative 1.

ALTERNATIVE 2

IMPACT MECHANISMS RELATED TO RESERVOIR OPERATIONS

Sacramento River Region

Shasta Lake. Under Alternative 2, the high water level and the low water level would be the same as under the No-Action Alternative. No impact on cultural resources would occur.

Under Alternative 2, annual visitor use days at Shasta Lake would decrease less than 2 percent from the annual use estimated for the No-Action Alternative. This amount of change would not likely have an impact on cultural resources.

Lake Oroville. Under Alternative 2, Lake Oroville's high water level would remain constant and the low water level would be 4 feet lower than under the No-Action Alternative. This amount of fluctuation would not have an impact on cultural resources.

Under Alternative 2, annual visitor use days at Lake Oroville would increase less than 1 percent. This increase in recreational use would not have an impact on cultural resources.

Folsom Lake. Under Alternative 2, the high water level at Folsom Lake would be the same as under the No-Action Alternative. The low water level would be 5 feet higher than under the No-Action Alternative. This amount of fluctuation would not have an impact on cultural resources.

Under Alternative 2, annual visitor use days at Folsom Lake would increase less than 2 percent from the annual use estimated for the No-Action Alternative. This amount of change would not have an impact on cultural resources.

San Joaquin River Region

The non-CVP and non-SWP reservoirs included in this analysis are Camanche Reservoir, Lake McClure, New Don Pedro Reservoir, and New Hogan Lake. The non-CVP and non-SWP rivers are the Tuolumne River and the Merced River. The hydrologic modeling conducted for this analysis has not included reoperation of non-CVP and non-SWP reservoirs. For more information, see the discussion under Analysis Methodologies.

Millerton Lake. Under Alternative 2, the high and low water levels at Millerton Lake would remain the same as under the No-Action Alternative. No impact on cultural resources would occur.

Under Alternative 2, annual visitor use days at Millerton Lake would remain the same as estimated for the No-Action Alternative. No impact on cultural resources would occur.

New Melones Reservoir. Under Alternative 2, New Melones Reservoir's high water level would remain the same as under the No-Action Alternative; however, the low water level would be 102 feet lower than under the No-Action Alternative. Resources could be exposed to

vandalism during periods when the reservoir is drawn down to these levels. New Melones Reservoir was subject to an extensive program of inventory, evaluation, and mitigation before it was filled. This program information should be consulted at the beginning of any Section 106 process related to changes in reservoir operations.

Under Alternative 2, annual visitor use days at New Melones Reservoir are expected to decrease less than 2 percent from the annual use estimated for the No-Action Alternative. This small change would not have an impact on cultural resources.

San Luis Reservoir. Under Alternative 2, the high water level at San Luis Reservoir would remain the same as under the No-Action Alternative. The low water level would be 5 feet higher than under the No-Action Alternative. This amount of change would not have an impact on cultural resources.

Under Alternative 2, annual visitor use days at San Luis Reservoir are expected to increase less than 1 percent from the annual use estimated for the No-Action Alternative. This amount of change in recreational use would not have an impact on cultural resources.

Non-CVP and Non-SWP Reservoirs. Under Alternative 2, the high water levels would remain the same and the low water levels would range from 3 feet higher to 31 feet lower than levels under the No-Action Alternative. Resources could be exposed to vandalism during periods when a reservoir is drawn down to these levels.

Under Alternative 2, annual visitor use days would decrease less than 1 percent. This amount of change would not result in impacts on cultural resources.

IMPACT MECHANISMS RELATED TO STREAMFLOW CHANGES

Sacramento River Region

See the discussion under Alternative 1, Impact Mechanisms Related to Streamflow Changes under the Sacramento River Region.

Sacramento-San Joaquin Delta Region

See the discussion under Alternative 1, Impact Mechanisms Related to Streamflow Changes under the Sacramento River Region.

San Joaquin River Region

San Joaquin River. Under Alternative 2, the annual number of visitors to the San Joaquin River will decrease by less than 1 percent compared with the No-Action Alternative. This amount of change will not have an impact on cultural resources.

Stanislaus River. Under Alternative 2, the annual number of visitors to the Stanislaus River will increase by less than 3 percent compared with the No-Action Alternative. This amount of change will not have an impact on cultural resources.

Non-CVP and Non-SWP Rivers. Under Alternative 2, the annual number of visitors will increase by less than 1 percent compared with the No-Action Alternative. This amount of change will not have an impact on cultural resources.

IMPACT MECHANISMS RELATED TO LAND USE CHANGES

Sacramento River Region

Under Alternative 2, approximately 6,100 acres of agricultural land would be fallowed in the Sacramento River Region. No land would be retired in this region. The number of acres in orchards would be the same as under the No-Action Alternative, but the number of acres in rice production would decrease by 4,300 acres. This amount of change could result in a very minimal benefit to cultural resources.

Sacramento-San Joaquin Delta Region

Under Alternative 2, approximately 300 acres of agricultural land would be fallowed in the Sacramento-San Joaquin Delta Region. No land would be retired in this region. No change in the amount of land planted in orchards is expected, but 100 fewer acres are expected to be in rice production. This amount of change could result in a very minimal benefit to cultural resources.

San Joaquin River Region

Under Alternative 2, approximately 43,800 acres of agricultural land would be fallowed and 14,400 acres would be retired in the San Joaquin River Region. Orchard acreage would be reduced by 1,000 acres and rice production would be reduced by 900 acres. Fallowing 43,800 acres could provide a substantial benefit to cultural resources because resources that are located on this land would be relieved from any adverse impact that would result from ongoing agricultural practices.

Tulare Lake Region

Under Alternative 2, approximately 4,800 acres of agricultural land would be fallowed and 15,600 acres would be retired in the Tulare Lake Region. Land in production for orchards would decrease by 200 acres and there would be no change in the amount of rice produced. The fallowing of 4,800 acres could provide a benefit to cultural resources because resources that are located on these acres would be relieved from the impact that results from ongoing agricultural practices.

IMPACT MECHANISMS RELATED TO TERRESTRIAL HABITAT RESTORATION

Sacramento River Region

No terrestrial habitat restoration is planned on the land fallowed in the Sacramento River Region under Alternative 2 and no land would be retired. No impacts on cultural resources would occur.

Sacramento-San Joaquin Delta Region

No terrestrial habitat restoration is planned on the land fallowed in the Sacramento-San Joaquin Delta Region under Alternative 2 and no land would be retired. No impacts on cultural resources would occur.

San Joaquin River Region

Under Alternative 2, none of the land fallowed in the San Joaquin River Region would be restored, but all 14,400 acres proposed for retirement would be naturally reseeded as annual grasslands. This reseeding has very low potential to affect cultural resources because little or no ground disturbance would be required.

Tulare Lake Region

Under Alternative 2, none of the land fallowed in the Tulare Lake Region would be restored, but approximately 15,600 acres of retired land could be naturally reseeded as annual grasslands. As described for the San Joaquin River Region, this restoration would have a very low potential to affect cultural resources.

IMPACT MECHANISMS RELATED TO INCREASED WATER DELIVERIES TO REFUGES

Under Alternative 2, all refuges would receive Level 4 water, resulting in the delivery of more water than under the No-Action Alternative. Deliveries to the Sacramento River Region refuges would increase by 40 percent, to the San Joaquin River refuges would increase by 120 percent, and to the Tulare Lake Region refuges would increase by 113 percent. Reduced deliveries to refuges would be possible during dry years. Deliveries to refuges would be reduced by the same percentage as reductions for other users receiving water from the same sources.

Cultural resources in the areas receiving additional water could be flooded or subjected to increased erosion. Under Alternative 2, Level 4 water would be supplied to the refuges and recreation would increase over the No-Action Alternative. Recreation in the Sacramento River Region would increase by an estimated 63 percent, by an estimated 42 percent in the San Joaquin River Region, and by an estimated 150 percent in the Tulare Lake Region. This additional visitation would increase the potential for sites to be vandalized.

IMPACT MECHANISMS RELATED TO ANADROMOUS FISHERIES HABITAT RESTORATION

Some of the projects currently proposed to improve anadromous fisheries habitat under Alternative 2 include considerable ground disturbance and are likely to affect cultural resources. Many of the projects are proposed to occur in areas that have a high probability of containing cultural resources. These projects would occur in all study regions except the Tulare Lake Region.

Direct impacts on cultural resources could result from the effects of constructing and operating new facilities and modifying existing facilities. Tables III-2, III-3, and III-4 in the Fisheries Technical Appendix show the fisheries restoration activities that would occur under Alternative 2.

ALTERNATIVE 3

IMPACT MECHANISMS RELATED TO RESERVOIR OPERATIONS

Sacramento River Region

Shasta Lake. Under Alternative 3, the high water level would be the same as under the No-Action Alternative. The low water level would be 1 foot higher than under the No-Action Alternative. This amount of fluctuation would not have an impact on cultural resources.

Under Alternative 3, annual visitor use days at Shasta Lake would decrease less than 2 percent from the annual use estimated for the No-Action Alternative. This amount of change would not likely have an impact on cultural resources.

Lake Oroville. Under Alternative 3, Lake Oroville's high water level would remain constant and the low water level would be 2 feet higher than under the No-Action Alternative. This amount of fluctuation would not have an impact on cultural resources.

Under Alternative 3, annual visitor use days at Lake Oroville would increase less than 2 percent from the annual use estimated for the No-Action Alternative. This increase in recreational use would not have an impact on cultural resources.

Folsom Lake. Under Alternative 3, the high water level at Folsom Lake would be the same as under the No-Action Alternative, and the low water level would be 5 feet higher than under the No-Action Alternative. This amount of fluctuation would not have an impact on cultural resources.

Under Alternative 3, annual visitor use days at Folsom Lake would increase less than 2 percent from the annual use estimated for the No-Action Alternative. This amount of change would not have an impact on cultural resources.

San Joaquin River Region

The non-CVP and non-SWP reservoirs included in this analysis are Camanche Reservoir, Lake McClure, New Don Pedro Reservoir, and New Hogan Lake. The non-CVP and non-SWP rivers are the Tuolumne River and the Merced River. The hydrologic modeling conducted for this analysis has not included reoperation of non-CVP and non-SWP reservoirs. For more information, see the discussion under Analysis Methodologies.

Millerton Lake. Under Alternative 3, the high and low water levels at Millerton Lake would remain the same as under the No-Action Alternative. No impact on cultural resources would occur.

Under Alternative 3, annual visitor use days at Millerton Lake would remain the same as estimated for the No-Action Alternative. No impact on cultural resources would occur.

New Melones Reservoir. Under Alternative 3, New Melones Reservoir's high water level would be 4 feet lower than under the No-Action Alternative. The low water level would be 111 feet lower than under the No-Action Alternative. Cultural resources could be exposed to vandalism during periods when the reservoir is drawn down to these levels. New Melones Reservoir was subject to an extensive program of inventory, evaluation, and mitigation before it was filled. This program information should be consulted at the beginning of any Section 106 process related to changes in reservoir operations.

Under Alternative 3, annual visitor use days at New Melones Reservoir are expected to decrease less than 2 percent from the annual use estimated for the No-Action Alternative. This small change would not have an impact on cultural resources.

San Luis Reservoir. Under Alternative 3, the high and low water levels at San Luis Reservoir would remain the same as under the No-Action Alternative. No impact on cultural resources would occur.

Under Alternative 3, annual visitor use days at San Luis Reservoir are expected to decrease less than 1 percent from the annual use estimated for the No-Action Alternative. This amount of change in recreational use would not have an impact on cultural resources.

Non-CVP and Non-SWP Reservoirs. Under Alternative 3, the high water levels would vary up to 1 foot lower than levels under the No-Action Alternative. The low water levels would range from 38 feet higher to 38 feet lower than levels under the No-Action Alternative. Resources could be exposed to vandalism during periods when a reservoir is drawn down to these levels.

Under Alternative 3, annual visitor use days would increase less than 1 percent. This amount of change would not result in impacts on cultural resources.

IMPACT MECHANISMS RELATED TO STREAMFLOW CHANGES

Sacramento River Region

See the discussion under Alternative 1, Impact Mechanisms Related to Streamflow Changes under the Sacramento River Region.

Sacramento-San Joaquin Delta Region

See the discussion under Alternative 1, Impact Mechanisms Related to Streamflow Changes under the Sacramento River Region.

San Joaquin River Region

San Joaquin River. Under Alternative 3, the annual number of visitors to the San Joaquin River will decrease by less than 1 percent compared with the No-Action Alternative. This amount of change will not have an impact on cultural resources.

Stanislaus River. Under Alternative 3, the annual number of visitors to the Stanislaus River will increase by less than 7 percent compared with the No-Action Alternative. This amount of change could result in an impact on cultural resources from an increased potential for vandalism.

Non-CVP and Non-SWP Rivers. Under Alternative 3, the annual number of visitors will increase by less than 5 percent compared with the No-Action Alternative. This amount of change could result in an effect on cultural resources.

IMPACT MECHANISMS RELATED TO LAND USE CHANGES

Sacramento River Region

Under Alternative 3, approximately 23,100 acres of agricultural land would be fallowed in the Sacramento River Region. No land in this region would be retired. The number of acres in orchards would be reduced by 400 and rice production would decrease by 12,700 acres. This amount of change could result in a very minimal benefit to cultural resources.

Sacramento-San Joaquin Delta Region

Under Alternative 3, approximately 1,500 acres of agricultural land would be fallowed in the Sacramento-San Joaquin Delta Region. No land in this region would be retired. The number of acres in orchards would be reduced by 100, compared to the No-Action Alternative, and 100 fewer acres are expected to be in rice production. This amount of change could result in a very minimal benefit to cultural resources.

San Joaquin River Region

Under Alternative 3, approximately 108,100 acres of agricultural land would be fallowed and 14,400 acres would be retired in the San Joaquin River Region. Orchard acreage would be reduced by 3,200 acres and rice production would be reduced by 2,900 acres. The fallowing of 108,100 acres could provide a substantial benefit to cultural resources because resources located on these acres would be relieved from any adverse impacts that would result from ongoing agricultural practices. Benefits would also occur from the reduction of orchards and rice production because cultivating these crops has a high potential to disturb cultural resources.

Tulare Lake Region

Under Alternative 3, approximately 4,100 acres of agricultural land would be fallowed and 15,600 acres would be retired in the Tulare Lake Region. Land in production for orchards would decrease by 200 acres and rice production would remain the same as under the No-Action Alternative. The fallowing of 4,100 acres could provide a benefit to cultural resources because resources located on these acres would be relieved from any adverse impacts that would result from ongoing agricultural practices.

IMPACT MECHANISMS RELATED TO TERRESTRIAL HABITAT RESTORATION

Sacramento River Region

No terrestrial habitat restoration is planned on the land fallowed in the Sacramento River Region under Alternative 3 and no land would be retired. No impacts on cultural resources would occur.

Sacramento-San Joaquin Delta Region

No terrestrial habitat restoration is planned on the land fallowed in the Sacramento-San Joaquin Delta Region under Alternative 3 and no land would be retired. No impacts on cultural resources would occur.

San Joaquin River Region

Under Alternative 3, approximately 16,200 acres of the land fallowed in the San Joaquin River Region would be restored, and all 14,400 acres proposed for retirement would be reseeded as annual grasslands.

Conservation easements would be acquired on the 15 percent of the fallowed lands, and the management of these lands would include vegetation and wildlife objectives. This type of restoration would involve little or no land reshaping and thus would have no more impacts on cultural resources than current farming practices. As described under Alternative 1, the reseeding program for retired drainage lands would have a very low probability of affecting cultural resources.

Tulare Lake Region

Under Alternative 3, none of the land fallowed in the Tulare Lake Region would be restored, but approximately 15,600 acres of retired land would be reseeded as annual grasslands. As described for the San Joaquin River Region, this restoration would have a very low probability of affecting cultural resources.

IMPACT MECHANISMS RELATED TO INCREASED WATER DELIVERIES TO REFUGES

Under Alternative 3, all refuges would receive Level 4 water, resulting in the delivery of more water than under the No-Action Alternative. Deliveries to the Sacramento River Region refuges

would increase 40 percent, to the San Joaquin River refuges by 120 percent, and to the Tulare Lake Region refuges by 113 percent. Reduced deliveries to refuges would be possible during dry years. Deliveries to refuges would be reduced by the same percentage as reductions for other users receiving water from the same sources.

Cultural resources in the areas receiving additional water could be flooded or subjected to increased erosion. Under Alternative 3, Level 4 water would be supplied to the refuges and recreation would increase over the No-Action Alternative. Recreation in the Sacramento River Region would increase by an estimated 63 percent, by an estimated 42 percent in the San Joaquin River Region, and by an estimated 150 percent in the Tulare Lake Region. This additional visitation would increase the potential for sites to be vandalized.

IMPACT MECHANISMS RELATED TO ANADROMOUS FISHERIES HABITAT RESTORATION

Some of the projects currently proposed to improve anadromous fisheries habitat under Alternative 3 include considerable ground disturbance and are likely to affect cultural resources. Many of the projects are proposed to occur in areas that have a high probability of containing cultural resources. These projects would occur in all study regions except the Tulare Lake Region. Direct impacts on cultural resources could result from the effects of constructing and operating new facilities and modifying existing facilities. Tables III-2, III-3, and III-4 in the Fisheries Technical Appendix show the fisheries restoration activities that would occur under Alternative 3.

ALTERNATIVE 4

IMPACT MECHANISMS RELATED TO RESERVOIR OPERATIONS

Sacramento River Region

Shasta Lake. Under Alternative 4, the high water level would be the same as under the No-Action Alternative and the low water level would be 1 foot lower than under the No-Action Alternative. This amount of fluctuation would not have an impact on cultural resources.

Under Alternative 4, the annual visitor use days for Shasta Lake would decrease less than 2 percent from the annual use estimated for the No-Action Alternative. This amount of change would not likely have an impact on cultural resources.

Lake Oroville. Under Alternative 4, the high water level would remain constant and the low water level would be 6 feet higher than under the No-Action Alternative. This amount of fluctuation would not have an impact on cultural resources.

Under Alternative 4, annual visitor use days at Lake Oroville would increase less than 1 percent. This increase in recreational use would not have an impact on cultural resources.

Folsom Lake. Under Alternative 4, the high water level at Folsom Lake would be the same as under the No-Action Alternative, and the low water level would be 5 feet higher than under the No-Action Alternative. This amount of fluctuation would not have an impact on cultural resources.

Under Alternative 4, annual visitor use days at Folsom Lake would increase less than 2 percent from the annual use estimated for the No-Action Alternative. This amount of change would not have an impact on cultural resources.

San Joaquin River Region

The non-CVP and non-SWP reservoirs included in this analysis are Camanche Reservoir, Lake McClure, New Don Pedro Reservoir, and New Hogan Lake. The non-CVP and non-SWP rivers are the Tuolumne River and the Merced River. The hydrologic modeling conducted for this analysis has not included reoperation of non-CVP and non-SWP reservoirs. For more information, see the discussion under Analysis Methodologies.

Millerton Lake. Under Alternative 4, the high and low water levels at Millerton Lake would remain the same as under the No-Action Alternative. No impact on cultural resources would occur.

Under Alternative 4, annual visitor use days at Millerton Lake would remain the same as estimated for the No-Action Alternative. No impact on cultural resources would occur.

New Melones Reservoir. Under Alternative 4, New Melones Reservoir's high water level would be 4 feet lower than under the No-Action Alternative. The low water level would be 111 feet lower than under the No-Action Alternative. Resources could be exposed to vandalism during periods when the reservoir is drawn down to these levels. New Melones Reservoir was subject to an extensive program of inventory, evaluation, and mitigation before it was filled. This program information should be consulted at the beginning of any Section 106 process related to changes in reservoir operations.

Under Alternative 4, annual visitor use days at New Melones Reservoir are expected to decrease less than 2 percent from the annual use estimated for the No-Action Alternative. This small change would not have an impact on cultural resources.

San Luis Reservoir. Under Alternative 4, the high water level at San Luis Reservoir would remain the same as under the No-Action Alternative. The low water level would be 5 feet higher than under the No-Action Alternative. The reservoir level change that would result from implementing Alternative 4 would not have an impact on cultural resources.

Under Alternative 4, annual visitor use days at San Luis Reservoir are expected to decrease less than 2 percent from the annual use estimated for the No-Action Alternative. This amount of change in recreational use would not have an impact on cultural resources.

Non-CVP and Non-SWP Reservoirs. Under Alternative 4, the high water levels would vary up to 1 foot lower than levels under the No-Action Alternative. The low water levels would

range from 38 feet higher to 38 feet lower than levels under the No-Action Alternative. Resources could be exposed to vandalism during periods when a reservoir is drawn down to these levels.

Under Alternative 4, annual visitor use days would increase less than 1 percent. This amount of change would not result in impacts on cultural resources.

IMPACT MECHANISMS RELATED TO STREAMFLOW CHANGES

Sacramento River Region

See the discussion under Alternative 1, Impact Mechanisms Related to Streamflow Changes under the Sacramento River Region.

Sacramento-San Joaquin Delta Region

See the discussion under Alternative 1, Impact Mechanisms Related to Streamflow Changes under the Sacramento River Region.

San Joaquin River Region

San Joaquin River. Under Alternative 4, the annual number of visitors to the San Joaquin River will decrease by less than 1 percent compared with the No-Action Alternative. This amount of change will not have an impact on cultural resources.

Stanislaus River. Under Alternative 4, the annual number of visitors to the Stanislaus River will increase by less than 7 percent compared with the No-Action Alternative. This amount of change could result in an impact on cultural resources from an increased potential for vandalism.

Non-CVP and Non-SWP Rivers. Under Alternative 4, the annual number of visitors will increase by less than 5 percent compared with the No-Action Alternative. This amount of change will not have an impact on cultural resources.

IMPACT MECHANISMS RELATED TO LAND USE CHANGES

Sacramento River Region

Under Alternative 4, approximately 22,600 acres of agricultural land would be fallowed in the Sacramento River Region. No land in this region would be retired. The number of acres in orchard would decrease by 400 compared to the No-Action Alternative, and 12,600 fewer acres of rice would be under production compared with the No-Action Alternative. The fallowing of 22,600 acres could provide a substantial benefit to cultural resources because resources that are located on these acres would be relieved from any impacts that would result from ongoing agricultural practices. Benefits would also occur from the reduction in rice production because agricultural practices related to this type of crop have a high potential to disturb cultural resources.

Sacramento-San Joaquin Delta Region

Under Alternative 4, approximately 1,600 acres of agricultural land would be fallowed. No land in this region would be retired. The number of acres in orchard would decrease by 100 compared to the No-Action Alternative, and 100 fewer acres of rice would be under production. This amount of change could result in a very minimal benefit to cultural resources.

San Joaquin River Region

Under Alternative 4, approximately 125,600 acres of agricultural land would be fallowed and 14,400 acres would be retired in the San Joaquin River Region. Orchard acreage would be reduced by 3,300 acres and rice production would be reduced by 3,100 acres. The fallowing of 125,600 acres could provide a substantial benefit to cultural resources because resources located on these acres would be relieved from the impacts that result from ongoing agricultural practices. Benefits would also occur from the reduction in orchards and rice under production because cultivation of these crops has a high potential to disturb cultural resources.

Tulare Lake Region

Under Alternative 4, approximately 10,600 acres of agricultural land would be fallowed and 15,600 acres would be retired in the Tulare Lake Region. Land in production for orchards would decrease by 300 acres and no rice would be produced. The fallowing of 10,600 acres could provide a benefit to cultural resources because resources located on these acres would be relieved from the impact that results from ongoing agricultural practices.

IMPACT MECHANISMS RELATED TO TERRESTRIAL HABITAT RESTORATION

Sacramento River Region

No terrestrial habitat restoration is planned on the land fallowed in the Sacramento River Region under Alternative 4 and no land would be retired. No impacts on cultural resources would occur.

Sacramento-San Joaquin Delta Region

No terrestrial habitat restoration is planned on the land fallowed in the Sacramento-San Joaquin Delta Region under Alternative 4 and no land would be retired. No impacts on cultural resources would occur.

San Joaquin River Region

Under Alternative 4, approximately 18,800 acres of the land fallowed in the San Joaquin River Region would be restored, and all 14,400 acres proposed for retirement would be reseeded as annual grasslands.

Conservation easements would be acquired on the 15 percent of the fallowed lands, and the management of these lands would include vegetation and wildlife objectives. This type of restoration would involve little or no land reshaping and thus would have no more impacts on

cultural resources than current farming practices. As described under Alternative 1, the reseeding program for retired drainage lands would have a very low probability of affecting cultural resources.

Tulare Lake Region

Under Alternative 4, none of the land fallowed in the Tulare Lake Region would be restored, but approximately 15,600 acres of retired land would be reseeded as annual grasslands. As described for the San Joaquin River Region, this restoration would have a very low probability of affecting cultural resources.

IMPACT MECHANISMS RELATED TO INCREASED WATER DELIVERIES TO REFUGES

Under Alternative 4, all refuges would receive Level 4 water resulting in the delivery of more water than under the No-Action Alternative. Deliveries to the Sacramento River Region refuges would increase 40 percent, deliveries to the San Joaquin River refuges would increase 120 percent, and deliveries to the Tulare Lake Region refuges would increase 113 percent. Reduced deliveries to refuges would be possible during dry years. Deliveries to refuges would be reduced by the same percentage as reductions for other users receiving water from the same sources.

Cultural resources in the areas receiving additional water could be flooded or subjected to increased erosion. Under Alternative 4, Level 4 water would be supplied to the refuges and recreational use would increase over the No-Action Alternative. Recreational use in the Sacramento River Region would increase by an estimated 63 percent, by an estimated 42 percent in the San Joaquin River Region, and by an estimated 150 percent in the Tulare Lake Region. This additional visitation would increase the potential for sites to be vandalized.

IMPACT MECHANISMS RELATED TO ANADROMOUS FISHERIES HABITAT RESTORATION

Some of the projects currently proposed to improve anadromous fisheries habitat under Alternative 4 include considerable ground disturbance and are likely to affect cultural resources. Many of the projects are proposed to occur in areas that have a high probability of containing cultural resources. These projects would occur in all study regions except the Tulare Lake Region. Direct impacts on cultural resources could result from the effects of constructing and operating new facilities and modifying existing facilities. Tables III-2, III-3, and III-4 in the Fisheries Technical Appendix show the fisheries restoration activities that would occur under Alternative 4.

CHAPTER IV

BIBLIOGRAPHY

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BIBLIOGRAPHY

Barrett, S.A., 1908, The Ethnogeography of Pomo and Neighboring Indians: University of California Publications in American Archaeology and Ethnology, Vol. 6, No. 1, pp. 1-322.

Basgall, M.E., and True, D.L., 1985, Archaeological Investigations in Crowder Canyon, 1973-1984: Excavations at Sites SBR-421B, SBR--421C, SBR-421D, and SBR-713. Report on file, Caltrans, Sacramento, CA.

Baumhoff, M.A., 1958, California Athabascan Groups: University of California Anthropological Records, Vol. 16, No. 5, pp. 157-238.

_____ , 1963, Ecological Determinants of Aboriginal California Populations: University of California Publications in American Archaeology and Ethnology, Vol. 49, No. 2, pp. 155-236.

Bean, L.J., 1978, Cahuilla, in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 575-587.

Bean, L.J., and Lawton, H.W., 1973, Some Explanations for the Rise of Cultural Complexity in Native California with Comments on Proto-Agriculture and Agriculture. Ramona: Ballena Press Anthropological Papers, Vol. 1, pp. i-xlvii.

Bean, L.J., and Shipek, F.C., 1978, Luiseno, in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 550-563.

Bean, L.J., and Smith, C.R., 1978a, Serrano, in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 570-574.

_____, 1978b, Cupeno, in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 588-591.

_____, 1978c, Gabrielino, in R.F. Heizer (ed.), Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 538-549.

Bean, L.J., and Theodoratus, D., 1978, Western Pomo and Northeastern Pomo, in R.F. Heizer, ed., Handbook of North American Indians. Volume 8: California: Washington, DC, Smithsonian Institution, pp. 289-305.

Beardsley, R.K., 1948, Cultural Sequences in Central California Archaeology: American Antiquity, Vol. 14, No. 1, pp. 1-28.

_____, 1954, Temporal and Areal Relationships in Central California Archaeology. University of California Archaeology Survey Reports 24, 25. Berkeley and Los Angeles, CA.

Bedwell, S.F., 1970, Prehistory and Environment of the Pluvial Fort Rock Lake Area of South-Central Oregon: Eugene, Department of Anthropology, University of Oregon, Ph.D. dissertation.

Bennyhoff, J., 1977, Ethnogeography of the Plains Miwok, Publication Number 5: Davis, CA, University of California, Center for Archaeological Research.

Blackburn, H.C., and Bean, L.J., 1978, Kitanemuk, in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 564-569.

Breschini, G.S.; Haversat, T.; Hampson, R.P.; and Archaeological Consulting, 1983, A Cultural Resources Overview of the Coast and Coast-Valley Study Areas: Salinas, CA, Prepared for U.S. Bureau of Land Management.

Bright, W., 1978, Karok, in R.F. Heizer, ed., Handbook of North American Indians. Volume 8: California: Washington, DC, Smithsonian Institution, pp. 180-189.

Callaghan, C.A., 1978, Lake Miwok, in R.F. Heizer (ed.), Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 264-273.

Chartkoff, J., and Chartkoff, K., 1975, Late Period Settlement of the Middle Klamath River of Northwest California: American Antiquity, Vol. 40, No. 2, pp. 172-179.

Clewett, E., 1974, Squaw Creek: A Multi-Component Early Archaic Site in Shasta County: unpublished report presented at the Society for California Archaeology Annual Data Sharing Meeting, Chico, California.

_____, 1977, CA-SHA-475: An Interim Report on Squaw Creek #1, a Complex Stratified Site in the Southern Klamath Mountains. Paper presented at the Symposium on the Archaeology of the North Coast Ranges, University of California, Davis.

Clewett, E., and Sundahl, E., 1983, Archaeological Excavations at Squaw Creek, Shasta County, California. Report on File, Shasta-Trinity National Forest, Redding, California.

Cook, S.F., 1943, The Conflict Between the California Indian and White Civilization: Ibero-Americana, Vol. 1, No. 21. University of California.

_____, 1955, The Epidemic of 1830-1833 in California and Oregon: University of California Publications in American Archaeology and Ethnology, Vol. 43, No. 3, pp. 303-326.

_____, 1956, The Aboriginal Population of the North Coast of California: University of California Anthropological Records, Vol. 16, No. 3, pp. 81-130.

_____, 1976, The Population of the California Indians, 1769-1970: Berkeley, University of California Press

_____, 1978, Historical Demography. In R.F. Heizer, vol. ed., Handbook of North American Indians, Vol. 8: California: 91-98. Washington, DC, Smithsonian Institution.

Curtis, E.S., [1930], The North American Indian: Being a Series of Volumes Picturing and Describing the Indians of the United States, and Alaska, 1907-1930, in F.W. Hodge, ed. 20 volumes: Norwood, MA, Plimpton Press.

Davis, J.T., 1961, Trade Routes and Economic Exchange Among the Indians of California. Archaeological Survey Reports Number 54: Berkeley, University of California Press.

_____, 1974, Trade Routes and Economic Exchange Among the Indians of California. Ballena Press Publication in Archaeology, Ethnology and History, Number 3: Socorro, NM, Ballena Press.

Dixon, R.B., 1910, The Chimariko Indians and Language: University of California Publications in American Archaeology and Ethnology, Vol. 5, No. 5, pp. 293-380.

Dondero, S.B.; Johnson, J.J.; and Tordoff, J.D., 1982, Archaeology, in Dutch Gulch Lake Intensive Cultural Resources Survey Report, J. Johnson, principal investigator, pp. 187-200. Report on File, U.S. Army Corps of Engineers. Sacramento, CA.

Dotta, J., and Hullinger, R., 1964, The Salvage Archaeology of a Wintu Fishing Station, CA-SHA-207, Shasta County, California. Report on File, Department of Parks and Recreation. Sacramento, CA.

Driver, H., 1936, Wappo Ethnography: University of California Publications in American Archaeology and Ethnology, Vol. 36, No. 3, pp. 179-220.

_____, 1939, Culture Element Distributions, X: Northwest California: University of California Anthropological Records, Vol. 1, No. 6, pp. 297-433.

Drucker, P., 1937, The Tolowa and Their Southwest Oregon Kin: University of California Publications in American Archaeology and Ethnology, Vol. 36, No. 4, pp. 221-300.

DuBois, C.A., 1935, Wintu Ethnography: University of California Publications in American Archaeology and Ethnology, Vol. 36, No. 1, pp. 1-148.

_____, 1936, The Wealth Concept as an Integrative Factor in Tolowa-Tututni Culture, in R. Lowie, ed., Essays in Anthropology, Presented to A.L. Kroeber in Celebration of His Sixtieth Birthday: Berkeley, University of California Press, pp. 49-65.

Elsasser, A.B., 1978a, Mattole, Nongatl, Sinkyone, Lassik, and Wailaki, in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 190-204.

_____, 1978b, Wiyot, in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 155-163.

Essene, F.J., 1942, Culture Element Distributions XXI: Round Valley: University of California Anthropological Records, Vol. 8, No. 1, pp. 1-97.

Foster, G.M., 1944, A Summary of Yuki Culture, University of California Anthropological Records, Vol. 5, No. 3, pp. 155-244.

Fredrickson, D.A., 1973, Early Cultures of the North Coast Range, California: Department of Anthropology, University of California, Davis, unpublished Ph.D. dissertation.

_____, 1974, Cultural Diversity in Early Central California: A View from the North Coast Ranges: Journal of California Anthropology, Vol. 1, No. 1, pp. 41-53.

Garfinkel, A.P., 1981, The Identification of Prehistoric Aboriginal Groups through the Study of Rock Art: manuscript, Sacramento, California Department of Transportation.

Garfinkel, A.P., and McGuire, K.R., 1980, Subsistence-Settlement Systems of the Southern Sierra Nevada, pp. 80-96 in A.P. Garfinkel, R.A. Schiffman, and K.R. McGuire, ed., Archaeological Investigations in the Southern Sierra Nevada: The Lamont Meadow and Morris Peak Segments of the Pacific Crest Trail: Prepared for Bureau of Land Management, Bakersfield District. Bakersfield, CA.

Garth, T.R., 1978, Atsugewi, in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 236-243.

Gayton, A.H., 1948, Yokuts and Western Mono Ethnography: University of California Anthropological Records, Vol. 10, Nos. 1-2, pp. 1-302.

Gerow, B.A., 1974, Co-Traditions and Convergent Trends in Prehistoric California: San Luis Obispo County Archaeological Society Occasional Papers, Vol. 8, pp. 1-58.

Gifford, E.W., 1923, Pomo Lands on Clear Lake: University of California Publications in American Archaeology and Ethnology, Vol. 20, No. 5, pp. 77-92.

_____, 1932, The North Fork Mono: University of California Publications in American Archaeology and Ethnology, Vol. 31, No. 2, pp. 15-65.

Goddard, P.E. [1904], Life and Culture of the Hupa, 1903-1904: University of California Publications in American Archaeology and Ethnology, Vol. 1, No. 1, pp. 1-88.

_____, 1907, Kato Texts: University of California Publications in American Archaeology and Ethnology, Vol. 5, No. 3, pp. 65-238.

_____, 1914, Notes on the Chilula Indians of Northwestern California: University of California Publications in American Archaeology and Ethnology, Vol. 10, No. 6, pp. 265-288.

Goldschmidt, W., 1978, Nomlaki, in R.F. Heizer, ed., Handbook of North American Indians, Vol. 8: California: Washington, DC, Smithsonian Institution, pp. 341-349.

Gould, R.A., 1966, The Wealth Quest Among the Tolowa Indians of Northwestern California: Proceedings of the American Philosophical Society, Vol. 110, No. 1, pp. 67-89.

_____, 1978, Tolowa, in R.F. Heizer, ed., Handbook of North American Indians. Volume 8: California: Washington, DC, Smithsonian Institution, pp. 128-136.

Grant, C., 1978a, Chumash, in R.F. Heizer, ed., Handbook of North American Indians. Volume 8: California: Washington, DC, Smithsonian Institution, pp. 505-508.

_____, 1978b, Eastern Coastal Chumash, in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 509-519.

_____, 1978c, Inland Chumash, in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 505-508.

_____, 1978d, Interior Chumash, in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 530-534.

Grayson, D.K., 1993, The Desert's Past: A Natural Prehistory of the Great Basin: Washington, DC, Smithsonian Institution Press.

Greengo, R., and Shutler, D., 1953, Historical Background, The Archaeology of the Napa Region, R.F. Heizer, ed., University of California Anthropological Records, Vol. 12, No. 6, pp.229-232.

Greenwood, R.S., 1978, Obiseno and Purisimeno Chumash, in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 520-523.

Greenwood, R.S., and Shoup, L., 1983, Interim Report on Archaeological Testing and Historical Research at CA-SHA-1176, Post Mile 46.4, Sacramento River Canyon, Shasta County, California: Report on file, California Department of Transportation, Sacramento, CA. Prepared for California Department of Transportation, Sacramento, CA.

Harrington, J.P., 1932, Karuk Indian Myths, Bulletin 107: Washington, DC, Bureau of American Ethnology.

_____, 1942, Culture Element Distributions, XIX: Central California Coast, Anthropological Records Vol. 7, No. 1, pp. 1-46.

Harrington, J.P., and Merriam, C., 1967, Chimariko Notes, in Ethnographic Notes on California Indian Tribes, II: Ethnological Notes on Northern and Southern California Tribes, R.F. Heizer, ed., Archaeological Survey Reports, #69: Berkeley, University of California Press, pp. 226-229.

Heizer, R.F., 1949, The Archaeology of Central California, I: The Early Horizon. Berkeley: University of California Anthropological Records, Vol. 12, No. pp. 1-84.

_____, 1953, The Archaeology of the Napa Region, University of California Anthropological Records, Vol. 12, No. 6, pp. 225-358.

_____, 1978, Handbook of the North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution.

Heizer, R.F., and Fenenga, F., 1939, Archaeological Horizons in Central California: American Anthropologist, Vol. 41, No. 3, pp. 378-399.

Hester, T.R., 1978a, Esselen, in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 496-499.

Hudson, Travis and Thomas C. Blackburn. The Material Culture of the Chumash Interactions Sphere, Vol. 1-V; 1982-1987. Ballena Press, Menlo Park.

Hudson, Travis and Ernest Underhay. Crystals In the Sky: An Intellectual Odyssey Involving the Chumash Astronomy, Cosmology and Rock Art. 2nd Printing, 1978. Ballena Press, Menlo Park.

_____, 1978b, Salinan, in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 500-504.

Jackson, T.L., 1975, Metates in the Sky, Rocks in the Head: Report on File, U.S. Forest Service, Regional Office. San Francisco, CA.

Jensen, P.M., and Farber, A., 1982, Archaeological Test Excavations at Site CA-TRI-205, Second Season's Fieldwork: Report on File, State of California, Department of Transportation. Sacramento, CA.

Jensen, P.M., and Reed, P.R., 1980, A Cultural Resources Inventory and Anthropological Overview of the Northern Sacramento Valley and Southern Cascade Range, special publication, U.S. Bureau of Land Management: Redding, CA, Redding District Office.

Johnson, J.J., 1978, Yana, in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 361-369.

_____, 1984, Dutch Gulch Lake, Intensive Cultural Resources Survey. Report on Filoe, Northeast California Information, California State University, Chico, and U.S. Army Corps of Engineers, Sacramento District Office.

Johnson, P.J., 1978, Patwin, in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 350-360.

Kelly, I., 1978, Coast Miwok, in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 414-425.

King, C., and Blackburn, T.C., 1978, Tatviam, in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 535-537.

Kroeber, A.L., 1925, Handbook of the Indians of California, Bureau of American Ethnology Bulletin 78.

_____, 1932a, The Patwin and Their Neighbors: University of California Publications in American Archaeology and Ethnology, Vol. 29, No. 4, pp. 253-423.

_____, 1932b, Cultural and Natural Areas of Native North America, University of California. Publications in American Archaeology and Ethnology, Vol. 38, pp. 1-242: Berkeley, CA, reprinted by University of California Press, 1963.

_____, 1939, Cultural and Natural Areas of Native North America. Berkeley: University of California Publications in American Archaeology and Ethnology, Vol. 38, pp. 1-240.

Kroeber, A.L., and Barrett, S.A., 1960, Fishing Among the Indians of Northwestern California: University of California Publications in American Archaeology and Ethnology, Vol. 21, No. 1, pp. 1-210.

La Pena, F.R., 1978, Wintu, in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 324-340.

Lenihan, D.J.; Carrell, T.L.; Fosberg, S.; Murphy, L.; Rayl, S.L.; and Ware, J.A., 1981, The Final Report of the National Reservoir Inundation Study, Volume I: Santa Fe, NM, National Park Service.

Levy, R., 1978a, Costanoan, in R.F. Heizer (ed.), Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 485-495.

_____, 1978b, Eastern Miwok, in R.F. Heizer (ed.), Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 398-413.

Lilliard, J.B.; Heizer, R.F.; and Fenenga, F., 1939, An Introduction to the Archaeology of Central California: Sacramento Junior College, Department of Anthropology Bulletin 2. Sacramento, CA.

Loeb, E.M., 1932, The Western Kuksu Cult: University of California Publications in American Archaeology and Ethnology, Vol. 33, No. 1, pp. 1-137.

Luomala, K., 1978, Tipai and Ipai, in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 492-609.

Mason, J.A., 1912, The Ethnology of the Salinan Indians: University of California Publications in American Archaeology and Ethnology, Vol. 10, No. 4, pp. 97-240.

_____, 1918, The Language of the Salinan Indians: University of California Publications in American Archaeology and Ethnology, Vol. 14, No. 1, pp. 1-154.

McCarthy, H., 1984, Ethnographic, Ethnohistoric and Historic Background, in Walnut Creek Project: Test Excavation and Evaluation of Archaeological Site CA-CCO-431, Contra Costa County, California, California Archaeological Consultants: Prepared for U.S. Army Corps of Engineers, Sacramento, CA.

_____, 1985a, Linguistics and Its Implications for California Ethnogeography and Culture History, in Ethnography and Prehistory of the North Coast Ranges, California, Publication Number 8: Davis, CA, University of California, Center for Archaeological Research, 20-35.

_____, 1985b, Ethnography, in Ethnography and Prehistory of the North Coast Ranges, California, Publication Number 8: Davis, CA, University of California, Center for Archaeological Research, pp. 36-86.

McCarthy, H.; Hildebrandt, W.R.; and Swenson, L., 1985, Ethnography and Prehistory of the North Coast Ranges, California, Publication Number 8: Davis, CA, University of California, Center for Archaeological Research.

McClellan, C., 1953, Ethnography of the Wappo and Patwin, in the Archaeology of the Napa Region, R.F. Heizer, ed., University of California Anthropological Records, Vol. 12, No. 6, pp. 233-241.

McKern, W.C., 1922, Functional Families of the Patwin: University of California Publications in American Archaeology and Ethnology, Vol. 13, No. 7, pp. 235-258.

_____, 1923, Patwin Houses: University of California Publications in American Archaeology and Ethnology, Vol. 20, No. 10, pp. 159-171.

McLendon, S., and Lowy, M.J., 1978, Eastern Pomo and Southeastern Pomo, in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 306-323.

McLendon, S., and Oswalt, R.L., 1978, Pomo: Introduction, in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 274-288.

Meighan, C.W., 1955, Archaeology of the North Coast Ranges, California: University of California, Archaeological Survey Report, Vol. 30, pp. 1-39.

Meighan, C.W., and Haynes, C.V., 1970, The Borax Lake Site Revisited: Science, Vol. 167, pp. 1213-1221.

Meighan, C.W.; Dillon, B.D.; Armstrong, D.V.; and Farnsworth, P., 1988, Success Lake Intensive Cultural Resources Survey: Los Angeles, CA, The Institute of Archaeology, University of California. Prepared for U.S. Army Corps of Engineers, Sacramento, CA.

Menefee, C.A., 1873, Historical and Descriptive Sketch Book of Napa, Sonoma, Lake, and Mendocino Comprising Sketches of the Topography, Products, History, Scenery and Peculiar Attention: Napa City, CA, Reporter Publishing House.

Merriam, C.H., 1955, Studies of California Indians; edited by the staff of the Department of Anthropology, University of California, Berkeley: Berkeley, University of California Press.

_____, 1966, Ethnographic Notes on California Indian Tribes; edited by the staff of the Department of Anthropology, University of California, Berkeley: Berkeley, University of California Press.

Miller, V.P., 1978, Yuki, Huchnom, and Coast Yuki, in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 249-255.

_____, 1979, Ukomno'm: The Yuki Indians of Northern California, Anthropological Papers, Number 14: Socorro, NM, Ballena Press.

Moratto, M.J., 1984, California Archaeology: New York, Academic Press.

Myers, J.E., 1978, Cahto, in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 244-248.

National Park Service, 1983, Archeology and Historic Preservation; Secretary of the Interior's Standards and Guidelines. U.S. Department of the Interior. Washington, DC.

_____, 1985, National Register Bulletin 24--Guidelines for Local Surveys: A Basis for Preservation Planning. Washington, DC, U.S. Department of the Interior.

_____, 1991. National Register Bulletin No. 15: How to Apply the National Register Criteria for Evaluation. U.S. Department of the Interior. Washington, DC.

Nomland, G., 1938, Bear River Ethnography: University of California Anthropological Records, Vol. 2, No. 2, pp. 91-124.

Olmsted, D.L., and Stewart, O.C., 1978, Achumawi, in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 225-235.

Pilling, A.R., 1978, Yurok, in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 137-154.

Powers, S., 1877, (1976), Tribes of California. Washington, D.C.: U.S. Department of the Interior, Geographical and Geological Survey of the Rocky Mountain Region, Contributions to North American Ethnology, III: (Reprinted in 1976 as Tribes of California.) Berkeley and Los Angeles: University of California Press.

_____, 1976, Tribes of California, originally published 1877, Contributions to North American Ethnology, Number 3. U.S. Geographical and Geological Survey of the Rocky Mountain Region: Washington, DC.

Radin. P., 1924, Wappo Texts: First Series: University of California Publications in American Archaeology and Ethnology, Vol. 19, No. 1, pp. 1-147.

Ragir, S.R., 1972, The Early Horizon in Central California Prehistory: Contributions of the University of California Archaeological Research Facility 15. Berkeley.

Raven, C.; Goldberg, S.K.; Moratto, M.J.; and Banks, K.M.; and others, 1984, Archaeological Investigations in the Sacramento River Canyon, Volume 1: Report of Testing at Seven Aboriginal Sites: Report on File, California Department of Transportation. Sacramento, CA. Prepared for California Department of Transportation, Sacramento, CA.

Riddell, F.A., 1978, Maidu and Konkow in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 370-386.

Sawyer, J.O., 1978, Wappo, in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 256-263.

Schenck, W.E., and Dawson, E.J., 1929, Archaeology of the Northern San Joaquin Valley, in University of California Publications in American Archaeology and Ethnology, Vol. 25, No. 4, pp. 289-413.

Schulz, P.D., 1970, Solar Burial Orientation and Paleodemography in Central California Windmiller Tradition: Center for Archaeological Research Publications, Vol. 2, pp. 185-198. Davis, University of California.

Shipley, W.F., 1978, Native Languages of California, in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 80-90.

Silver, S., 1978a, Chimariko, in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 205-210.

_____, 1978b, Shastan Peoples, in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 211-224.

Smith, C.E., and Weymouth, W.D., 1952, Archaeology of the Shasta Dama Area, California: University of California Archaeological Survey Report No. 18. Berkeley.

Smith, C.R., 1978, Tabatulabal, in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 437-445.

Spier, R.F.G., 1978a, Monache, in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 426-436.

_____, 1978b, Foothill Yokuts, in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 471-484.

Sundahl, E. 1982. The Shasta Complex in the Redding Area. Chico, Department of Anthropology, California State University, Master's thesis.

Treganza, A.E., 1958, Salvage Archaeology in the Trinity Reservoir Area, Northern California: University of California Archaeological Survey Report, Vol. 43, pp. 1-38.

_____, 1959, Salvage Archaeology in the Trinity Reservoir Area, Northern California, Field Season 1958: University of California Archaeological Survey Report, Vol. 46, pp. 1-32.

Treganza, A.E., and Heickson, M.H., 1960, Salvage Archaeology in the Whiskeytown Reservoir Area and the Wintu Pumping Plant, Shasta County, California. San Francisco State College, Occasional Papers in Anthropology, Vol. 1, pp. 1-49.

Van Bueren, T.M.;. Goldberg, S.K; Morotto, M.J.; Lee, P.; and Sorensen, J.H., 1989, Inventory and Evaluation of Cultural Resources, Bolsa Chica Mesa and Huntington Beach Mesa, Orange County, California. Report prepared by Infortec Research Incorporated. Fresno, CA. Prepared for the U.S. Army Corps of Engineers, Los Angeles District, Los Angeles, CA.

Voegelin, E., 1938, Tubatulabal Ethnography, University of California Publications in American Archaeology and Ethnology, Vol. 2, No. 1, pp. 1-84.

Wallace, W.J., 1954, The Little Sycamore Site and Early Milling Stone Cultures in Southern California. American Antiquity Vol. 20, No. 2, pp. 112-123.

_____, 1978a, Hupa, Chilula and Whilkut, in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 164-179.

_____, 1978b, Southern Valley Yokuts, in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 448-461.

_____, 1978c, Northern Valley Yokuts, in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 462-470.

Warren, C.N., and Crabtree, R.H., 1986, Prehistory of the Southwestern Area in R.F. Heizer, ed., Handbook of North American Indians, Volume 8: California: Washington, DC, Smithsonian Institution, pp. 180-189.

Whistler, K.A., 1977, Wintun Prehistory: An Interpretation Based on Reconstruction of Plant and Animal Nomenclature: Proceedings of the Third Annual Meeting of the Berkeley Linguistics Society: Berkeley, CA, Berkeley Linguistics Society, pp. 157-174.

Wilson, N.L., and Towne, A.H., 1978a, Nisenan, in R.F. Heizer, ed., Handbook of North American Indians, Vol. 8: California: Washington, DC, Smithsonian Institution.

_____, 1978b, Maidu and Konkow, in R.F. Heizer, ed., Handbook of North American Indians, Vol. 8: California: Washington, DC, Smithsonian Institution, pp. 370-386.

ATTACHMENT A

ETHNOGRAPHIC SOURCES RESEARCH

C-083379

Attachment A

ETHNOGRAPHIC SOURCES RESEARCH

This attachment documents the results of research into the published ethnographic research on Native American groups who lived or are living within the area that will be affected by the CVPIA. The bibliography to this attachment lists sources consulted during this research. The purpose of the research was to identify areas that could have traditional or sacred values to contemporary Native Americans. A question mark is used to denote that the source is not clear about a detail.

METHODS

To locate areas important in Native American cultures in counties affected by the project, primary archival sources were consulted. A bibliography was compiled using Volume 8 of the Handbook of North American Indians as a guide (Heizer, 1978). An often-used text, this volume summarizes the boundaries of territory, material culture, ethnography, and archeology of Native American groups in CVPIA study area. Citations in the text referring, even remotely, to important locales and areas in the cultural life or spiritual or mythological beliefs of each group were noted and sought out.

A bibliography was compiled by Jones & Stokes Associates staff and was sorted according to Native American group and author. Some sources had potential to yield information for more than one group. Jones & Stokes Associates staff undertook archival research at the University of California, Davis (UCD) Library and the California State Library. Academic titles were often unavailable at the California State Library but were present at the UCD Library. Old or rare volumes that were often not in the UCD collection were available for use in the closed stacks at the California State Library. Additional resources found while conducting this research were consulted and added to the bibliography.

Although Jones & Stokes Associates staff searched for every title, some sources could not be located and some that were located contained no applicable information. These have been noted in the bibliography. Information from the sources found was noted and forms the basis for this ethnographic summary.

NATIVE AMERICAN GROUPS

ACHUMAWI

The territory of the Achumawi was located along the lower drainage of the Pit River. Their villages were on the river itself or on the lower courses of its affluents, including Burney, Hat, and Dixie Valley (Horse) creeks (Kroeber, 1925:305-318). The White Horse Lake area was shared between the Fall River A-ju-mah-wi (Achumawi) and the Big Valley At-wum-we during

traditional fall deer hunts (Merriam, 1967:220). Mount Shasta was also a source of elk (Neasham, 1957:6).

A village called Mah-pe-dah-da, located on the creek of the same name (Salmon Creek) was reportedly a central salmon fishing camp used by several tribes in the Burney Creek area (Merriam, 1967:220). The Big Valley tribe customarily collected and dried salmon at Pit River falls (Merriam, 1967:220).

Obsidian was obtained primarily from Glass Mountain (near Medicine Lake [?]) and also from Sugar Mountain[?], which was considered sacred to the Hewisedawi group (Kniffen, 1928:303,309; Neasham, 1957:6). Mount Shasta plays a central role in the Achumawi and Atsugewi search-for-fire myth, when Owl goes to the top of the mountain to look all over the world for fire (Dixon, 1908:165).

ATSUGEWI

The Atsugewi believed that the interior of Mount Lassen contained powerful spirits and possibly Bald Mountain[?] also (Garth, 1953:186). An "old man" spirit reportedly resided at Slip'slip'isi, a cave near Lost Creek[?], and a spirit in Snag Lake[?] was believed to be the cause of a booming sound made by a rushing whirlpool of water in the lake (Garth, 1953:186).

Many natural features known to the Atsugewi were explained through the activities of mythological figures. For example, the lava flow in the center of Hat Creek Valley was thought to be the creation of Porcupine, as he endeavored to win a race with Coyote. Coyote also brought Eagle Lake to its present location (Garth, 1953:195). A 10-foot oblong rock, located 4 miles south of Pittville on an old village site, was interpreted as the petrified remains of a lizard killed by Butterfly, while it was believed that charm stones deposited by Coyote could be found at a place near Horse Creek, north of Dixie Valley (Garth, 1953:192,195).

CAHTO

Located in Mendocino County, the Cahto territory comprised the uppermost courses of the Eel River. Surrounded on three sides by the Yuki, the Cahto were the southernmost Athabaskans located along the Pacific Coast (Kroeber, 1925:154).

Blue Rock[?] was an important place of exchange with the Wailaki (Curtis, 1907-1930:4). A traditional fighting ground, known as Se'k'ang (Black Rock), was a dark rocky ridge located approximately 6 miles east of the reservation near Laytonville (Kroeber, 1928a:396).

Many of the figures in Cahto mythology were thought to reside on Red Mountain[?]. Here, fire was first stolen from Spider, and Kangaroo Rat, who was killed at Blue Rock[?], was resurrected at Red Mountain by Coyote (Goddard, 1907a:195-197,217-218). Other mythological events took place along the coast. "Yellow Hammer's Deeds" were said to have occurred at Kibesillah[?], and Seal, Sea Lion, and Grizzly had a dance house at Usal[?], where there were many sea lions (Goddard, 1907a:186,205).

CAHUILLA

Little ethnographic research has been conducted among the Cahuilla Indians of southern California until quite recently. What may be gleaned from early documentation indicates that the Santa Rosa[?] and San Jacinto Mountains figured strongly in Cahuilla mythology and in traditional hunting and foraging activities.

One myth features Santa Rosa as the place where the gods Mukat and Temaiyowit died and where the first people turned to rock (Gifford, 1918:189). Another myth relates that after Mukat had died, the people wandered off and those who made it to the top of the San Jacinto Mountains became birds (Hooper, 1920:376). Tahquitz Canyon in the San Jacinto Mountains was also known as the dwelling place of the fearsome Takwich, the first shaman (Hooper, 1920:364). Barrows, in his 1900 ethnobotanical study of the Cahuilla, stated that camps for annual sheep hunts were in the San Jacinto Mountains (Barrows, 1967:27).

Bean et al. (1991) documented a plethora of sites and objects considered religiously important or traditionally sensitive in Cahuilla culture, both past and present. Some examples of sacred sites and places now considered "national treasures" by the Cahuilla are listed here.

Hot springs and other desert oasis areas were very important sites in Cahuilla prehistory and history, and many are now considered sacred places. Agua Caliente in Palm Springs was reportedly a center of religious activity and figures strongly in Cahuilla mythology (p. 13 of Bean et al. 1991). Canyon de Cuerva[?] on Santa Rosa Mountain is known as Ahl-wah-hem'ke (House of Many Ravens) and is held in high religious regard (Bean et al., 1991, p. 39).

A few of the food and raw material collection locations now regarded as significant traditional sites among the Cahuilla are the Cactus Springs area (pinyon nut and medicinal plant gathering), Pinyon Hills (multi-village pinyon gathering), and the Mecca Hills (basalt collecting) (Bean et al., 1991, pp. 42-43,75-79). Fish trap petroglyphs[?], at locations of prehistoric fish traps, are treasured as symbols of their ancient past (Bean et al., 1991, p. 49). The San Jacinto Mountains remain important to the Cahuilla as traditional sheep hunting grounds, and areas where mountain sheep still range are especially treasured (Bean et al., 1991, p. 8).

CHIMARIKO

In historical times, Chimariko territory was limited to a 20-mile stretch of the canyon of the Trinity River, from above the mouth of South Fork to French Creek (Kroeber, 1925:109).

Ironsides Mountain (in Lake or Mendocino County[?]) was called Cha-lee-dan Ah-wood and was a place of pilgrimage used by the first people. When they became old, they would travel to the top of the mountain, pray there, and return home young again (Harrington and Merriam, 1967:226-227).

CHUMASH (INLAND)

When the Spanish padres traveled among the inland Chumash in the late 18th century, they noted that permanent springs and other reliable sources of good water were focal points of indigenous

life. In 1771, Fray Juan Crespi made this observation regarding springs in the San Antonio Valley, before San Bernabe[?] and near San Miguel (Crespi, 1927). In addition to being sources of potable water in an arid environment, springs in the Chumash area were also sites of pictographs representing magical or religious activities (Grant, 1965:89).

CHUMASH (COASTAL)

According to Engelhardt (1930), "in the vicinities of their rancherias and on the mountains, they used to have some places which they kept very clean, swept, and adorned with beautiful plumage put on poles." These were the sacred places of the Chumash, where they would place offerings of acorns, seeds, and wild fruits, and would pray for rain, health, and other requests (Engelhardt, 1930:34-35).

COSTANOAN

Some information regarding the precontact cultural traditions of the Costanoans has been gleaned from mission records and from limited ethnographic sources. [Big?] Sur was a gathering area for mescal [agave?], an important food plant to the Costanoans (Merriam, 1967:373). They also traveled more than 40 miles to the Pacheco Pass region to collect a type of food tuber, and bunchgrass root fibers were collected specially from areas around Watsonville for basket making (Merriam, 1967:381-382).

The Costanoan creation myth features a single mountaintop, which rises above the world after it was covered by water. Around Monterey, this mountain is Pico Blanco; further north it is Mount Diablo (Kroeber, 1925:472).

ESSELEN

No locational information applicable to the CVPIA PEIS was found in the sources consulted.

GABRIELINO

Kroeber (1925) stated that many burials were found on Santa Catalina, while the mainland is "remarkably free of ancient human bones." Exceptions are directly across from Santa Catalina, including Topanga, Santa Monica, Redondo, and San Pedro (Kroeber, 1925:633). This only seems to indicate that Gabrielino cemeteries may have been located in mountains and canyons near the coast, and particularly on Santa Catalina Island.

HUPA, CHILULA, AND WHILKUT

Salmon weirs were traditionally built by the Hupa on the Trinity River, located in alternate years at the villages of Medildin and Takimildin (Goddard, 1903:24). Locations of "resting places" with offerings were noted in Chilula territory by Goddard (1914:280); it is uncertain whether these refer to cemeteries or to another type of sacred or significant area.

In Hupa mythology, Yimantuwinyai (the Creator) came into being at a place below Martin's Ferry on the Klamath River, found other beings at Orleans Bar on the Klamath and in the sacred

house at the Takimildin (a village) on the Trinity River, and eventually settled at South Fork (Goddard, 1903:75). Another version of this story relates that Yimantuwinyai came into being at a Yurok village called Kenek (Kroeber, 1925:134).

A rocky crest of a certain ridge, northeast of "Lyon's place" (Goddard, 1914a:278), is the location of several natural features that figure significantly in Chilula and Hupa religious beliefs. A large boulder split in half was known as Yimantuwinyai's stone, behind which he hid to observe young maidens, and also an east/west line of stones, approximately 110 yards long, that Yimantuwinyai placed to attract maidens who would think the stones were babies (Goddard, 1914a:278-279). Also included on the crest of this ridge were a dancing-ground for those trying to become shamans, and a large depression around which adolescent girls ran during coming-up ceremonies (Goddard, 1914a:278-279).

Deer-tending gods, called *tans* by the Hupa, resided at Mud Springs[?] and at Bald Hill[?], while venerated stones referred to as "story people" could be found on the east bank of the Trinity River between the villages of Tsewenaldin and Takimildin (Goddard, 1903:80).

IPAI-TIPAI (DIEGUENO OR KUMEYAAY)

Like most of the southern California tribes, salt was collected from the Salton Sink[sic] (Curtis, 1907-1930:50). The San Bernardino Mountains figured in Diegueno myth as the home of *Chaup*, translated (in the early 1900s) as the "embodied principle of meteors" (DuBois, 1905:106). A mountain in southern Nevada was the place where Diegueno people were created; it was also the destination of their souls or spirits after death (Curtis, 1907-1930:50).

KAROK

Bluff Creek[?] is a neutral fishing ground shared by both northern and southern Karok groups, who camped on the creek during winter salmon fishing (Merriam, 1967:203). The Karok also believed in two legendary fishing weirs from the days of the immortals, called Yu'timin and Ka'timin, located just below and above the mouth of the Salmon River (Kroeber and Barrett, 1960:10). These areas are natural falls or rapids on the river, and Kroeber and Barrett doubt that fishing weirs ever actually existed there (1960:10). According to earlier ethnographic documentation, however, the two locations identified also may be sacred or ceremonial village sites (Kroeber and Gifford, 1949:6).

Three primary locations are of major importance in the history of Karok religion and ceremony. Orlean's Flat, at or below the modern town of Orleans, was called Panamemk and was believed to be the home of Coyote (Bright, 1954:1; Harrington, 1931:152-154; Kroeber, 1925:99). Katimin is a sacred village site located on a bluff adjoining Sugarloaf Peak, just above the mouth of the Salmon River on the left bank of the Klamath (Kroeber, 1925:100). The third sacred site was called Inam, located at the mouth of Clear Creek.

"World-fixing" or "world-renewing" ceremonies were held each year at Panamemk, Inam, and Katamin. The focus of the ceremonies at Katamin was Mount Offield[?], a sacred mountain (Kroeber and Gifford, 1949:6,19). Coyote's fishery was located on Coyote Creek at the end of Wilder Gulch[?] (Bright, 1954:1; 1957:[?]; Harrington, 1931:152-154).

KITANEMUK

No locational information for the Kitanemuk was found applicable to the CVPIA PEIS.

KONKOW (NORTHWESTERN MAIDU)

The salt springs at Wheatland were the property of the Auburn/Colfax tribe [of Konkow]; Maidu from further south came here to steal the salt from them (Merriam, 1967:313). Like other Maidu tribes, the Konkow regarded the Sutter Buttes as the place from which spirits of the dead set out upon various courses (Kroeber, 1925:439).

LUISENO

Seasonal acorn gathering encampments belonging to the Luiseno were referred to as Wavam, Shouau, Shautushma, and Pavla (Sparkman, 1908a:191-192). The Luiseno shared with the Cahuilla their belief in Takwich or Takwish, a fearsome monster/divinity, sometimes seen as a meteor or shooting star, who lives in the San Jacintos (on San Jacinto Peak) and devours people. A rocky peak on Mount Palomar is where he "tenderizes" his victims (Sparkman, 1908a:221-222).

The main falls at Pauma Creek was believed to be inhabited by a being known as Koyul (Sparkman, 1908a:220). Mount San Gorgonio[?] and Temecula[?] are also mentioned frequently in Luiseno songs and myths (Kroeber, 1925:659,678-680).

MAIDU (NORTHEASTERN)

The northeastern Maidu collected a specific type of [wild?] sunflower seed from a small valley at the head of Clear Creek (a tributary of Spanish Creek), while raw material for ground stone implements was collected from a cave at Ota yaku yamani (possibly Coyote Peak) (Riddell, 1968:92). A well-known soda rock or salt rock, featured in Maidu mythology, was located on Indian Creek below Indian Falls (Riddell, 1968:90-91).

Large villages or village sites where Maidu ceremonials (called "Big Times") were held are Chilu'am inkomi, on Johnson Ranch between Crescent Mills and Taylorsville, Yetameto'non, at the confluence of Grizzly and Indian creeks in the Genesee Valley, and Wayapom'momi, just south of Coyote Springs Flat (Riddell, 1968:47,86,88). A site in Dublin Jack Ravine (where it meets the American Valley) is believed to be a mythological village where people were thrown into hot springs and cooked (Riddell, 1968:47).

The Maidu believed that the spirits of the dead journeyed to Sutter Buttes and entered a mysterious cave or cavern to eat spirit food before continuing to various destinations in the afterworld (Dixon, 1905:260). The buttes are referred to by all Maidu as *Onolaithoth*, meaning the Great Spirit Mountain (Kroeber, 1925:439).

The Maidu believed that the summit of Keddie Peak, just north of Indian Valley, was the resting place of the stone canoe in which the Creator and all others took refuge during the flood created to destroy Coyote (Dixon, 1905:265). Homer Lake, on the north side of Keddie Peak, contained

a snag from which one could dive down into the water and acquire the powers of a doctor or shaman (Riddell, 1968:88-90).

Coyote and the Creator were believed to have had dance houses at Durham, represented by huge circular depressions found there, and a dome-shaped rock outcrop on the grounds of the Quincy high school was said to be the sweat house of Coyote and Badger (Dixon, 1908:265; Riddell, 1968:50). More prominent natural features featured in various Maidu myths are Bald Rock, Hamilton Mountain, Honey Lake, and Indian and Oregon creeks (Dixon, 1902:80-102).

MATTOLE, NONGATL, SINKYONE, LASSIK, AND WAILAKI (SOUTHERN ATHAPASKANS)

The Indians of the Bear River area interpreted various bodies of water as having either good or bad qualities. Hollow stones on Morrison Creek were considered good luck places, while the Klamath River was thought of as wicked in general and the water in Mount Glen Creek (running into the Eel River) was believed to cause blindness (Nomland, 1938:118-122).

The Wailaki reportedly believed that supernatural beings lived in a pool of stagnant water below the mouth of Wilson Creek (on the north side of the main stream), causing them to avoid this area entirely (Gifford, 1923b). Also in Wailaki territory was a large stone on a ridge east of the old village of Senesteonataikai that represented a young maiden who turned to stone after being refused by the man of her dreams (Gifford, 1923b). In the early 20th century, Curtis noted that most Wailaki ceremonial activity took place at designated spots in or around active villages (Curtis, 1907-1930:31-33).

A Mattole myth tells of a flood during which the surviving people took refuge on Taylor's Peak (Powers, 1877:111).

MONACHE

The north bank of the Kings River (below the Mill Flat Creek confluence) was an important fishing place for the Monache (also called eastern Mono or Northfork Mono) (Gayton, 1948:256-258). Raw material for cooking stones and eating containers was collected from two steatite quarries on Table Mountain and near Fish Creek Mountain (Gifford, 1932). An important village site (Ko'o'nikwe, referring to human bone) was located on the east bank of Mill Flat Creek, where a large battle reportedly occurred (Gayton, 1948:256-258).

On the west bank of the Middle Fork Kings River is a rock formation where animals were believed to have held council in prehuman times (Gayton, 1948:257-258). After the creation, all the people assembled at Coso Springs (Curtis, 1907-1930:123).

Other sites featured in Monache mythology are Wutcunap (possibly Lake Ediza), a place near the headwaters of the San Joaquin River (called Duniguba), a pass on Mammoth trail called Haekaman, a high peak called Big Tom, and sites where rock walls were built near Table Mountain, above Friant, and west of Friant. Most of these locations were visited by mythological adventurers Haininu and Baumegwesu (Gifford, 1923c:301-367).

COAST MIWOK

A place called Indian Mound, on a high hill in redwood forest west of Occidental, was a large camp used seasonally by the Miwok for hunting and collecting acorns (Merriam, 1967:365). The best known and largest salt deposit was 3.5 miles north of Stonyford and 1 mile west of Big Stony Creek (Barrett and Gifford, 1933:241).

Important villages frequently mentioned in Coast Miwok myth are Kabe'l on the eastern slope of Rocky Point, and No'napoti in the eastern part of the town of Kelseyville (Barrett and Gifford, 1933:186-187, 197).

EASTERN MIWOK

Steatite quarries traditionally visited by the Miwok for raw materials mining are located in the walled canyon of the North Fork Tuolumne River, one on the outskirts of the town of Tuolumne (cut by the old Duckwall road) and the other on the south side of a canyon area called Tile (Barrett, 1933:211). Other traditional collection areas include Table Mountain, which yielded white paint for ceremonies, and "Salt Peak" near Blood's [?] on the road above Calaveras Big Trees, where salt was collected (Merriam, 1967:349-350).

A cemetery, where ceremonies were still performed in 1905, is located at the old rancheria on the east side of Wasamak Creek, roughly 0.5 mile below the Ahwahnee Hotel in Yosemite (Hart, 1967:325). Ceremonial houses of Miwok rancherias were not in every contemporary (1905) village, but were only in a few locations where all could gather. The Ghost Dance is held in two "modern" ceremonial centers, one in Knights Ferry on the Stanislaus River in Stanislaus County and one is Ione in Amador County (Gifford, 1926c:400). The Moloku dance (condor dance) and the Kalea dance were given at Kotolosaku on McCormick Ranch near Byrne's Ferry Road (Gifford, 1955:287).

Many sites that figure prominently in Eastern Miwok mythology are in Yosemite Valley. Half Dome and Washington Tower are central to the creation of the valley (Barrett, 1919:21-23). Spirits inhabit Bridal Veil Falls and the waters just below Yosemite Falls (Barrett, 1919:23). Mt. Diablo is the site of various important events (Barrett, 1919:6). Bower Cave, located on the old Coulterville Road into Yosemite Valley, was the home of the chiefs of the third peopling of the world, who eventually became birds and mammals (Barrett, 1919:3). A giant (Uwu'lin) died near Coulterville and bones (possibly mammoth bones) are said to have been recovered (Barrett, 1919:3).

LAKE MIWOK

The Lake Miwok sent their boys to Sulphur Bank to be initiated by the Pomo for the Kuksu ceremony and the boys from Sulphur Bank (Pomo) were sometimes brought to the Lake Miwok to be initiated for the ghost ceremony (Loeb, 1932:122-123).

NISENAN (SOUTHERN MAIDU)

Several areas are noted as traditional collection/fishing grounds. Salt was collected from the current town of Rocklin and near Cool on the Knickerbocker Ranch (Beals, 1933:365). An Indian rancheria and acorn gathering area are located "3 miles toward the Yuba river from the Johnson ranch located on Bear river" (Buffum, 1850:31-32). Preferred salmon fishing is on the Trinity River (Cook, 1976) and possible fishing grounds and a village are located 6 miles west of the Pit River (Delano, 1854:207).

In the precontact period, the Nisenan burned their dead at the village burning grounds (Beals, 1933:380). Later bodies were buried. There is a cemetery between Grass Valley and Nevada City where the dead from Auburn, Colfax and Forest Hill were buried (Beals, 1933:380). Another Indian grave is mentioned by Buffum (along with bedrock mortars [BRMs]) and Indian Hut) near "Camp Beautiful," location unknown (Buffum, 1850:26-28).

The Maidu burning ceremonies, *seda* and *gelato*, were held at Berry Creek, a ridge adjacent to Enterprise and Mooretown ridges (Loeb, 1933:157). Kuksu cult dances and ceremonies were held at Kadema, 8 miles north of Sacramento, and Pujune, 1-2 miles above Sacramento on a knoll (Kroeber, 1929:254, 267-268).

Butte Mountain, near Marysville, is the site of the first Hesi ceremony, which is observed by a boy who introduces it to his people (Loeb, 1933:194). Another mythologically significant site is a round hill in Amador County, located west of Ione and southeast of Carbondale, called *omsus*. This hill was feared because it was believed that dead shamans had a round house inside in which they danced (Beals, 1933:380).

NOMLAKI (CENTRAL WINTUAN)

The Nomlaki traded salt to the Yuki (Goldschmidt, 1951:336). This salt was obtained from beds on Elder Creek and at Newville (Goldschmidt, 1951:411). Pink chert or flint was obtained from Yolla Bolly Mountain (Goldschmidt, 1951:418) and obsidian was obtained from the Mt. Shasta region through trade (Goldschmidt, 1951:419).

The creation myth of the the Nomlaki is obviously influenced by Christianity. Saltu creates the ocean and the Sacramento River by dragging his cane (Goldschmidt, 1951:349). Two of everything are granted refuge on the Butte at Oroville during a great flood and later on Marysville Butte in the second flood (Goldschmidt, 1951:350).

Some springs, *Sawal*, are inhabited by spirits that can be good or bad (Goldschmidt, 1951:352). Lassen Butte is significant as the home of Norwan, the woman who started the great war among the first peoples (Curtin, 1898:497). Keles (mountain wolves/bad spirits) live at the head of Hazel Creek and have their sweat house on Wenempuidal, the high mountain near the left bank of the little Sacramento River (Curtin, 1898:497).

PATWIN

The Patwin gathered obsidian from near Wheatland and from the Marysville Buttes (Kroeber, 1932a:273). Fish dams, or weirs, were built at Koru (in Colusa city, the metropolis of the Colusa dialect) and at Saka (the metropolis of the Grimes dialect) (Kroeber, 1932a:278).

Powers mentions a huge burial ground on the Estes Ranch in Spring Valley (Powers, 1877:219) and a large number of bones were excavated at Vacaville (Powers, 1877).

The Marysville Buttes, or *Onolai,* are prominent in myths. Creation stories refer to the Marysville Buttes and the four sweat songs of the Hesi ceremony originated there (Kroeber, 1932a:305-308, 390). The village of Ko'doi, located 1 mile below Saka on the J. Brown place, is mentioned in many myths of the Patwin Grimes group (Kroeber, 1932a:305-308). Kosempu is the site of various ceremonies (Kroeber, 1932a).

POMO

Several sources of salt are mentioned. Salt was collected from Skagg Springs near Kobb Mountain and from a point on Cache Creek about 6 to 8 miles downstream from Lower Lake (Barrett, 1952:114). It was also obtained near the village of Che'etido (Kroeber, 1925:236), at Che'ha'ba, on the east side of the valley and from a salt spring at Kache'kma (Kroeber, 1932a). The Coastal people obtained salt from a big flat rock between Kabesilla and Chadburne gulch (Merriam, 1967:288). The largest and best known salt source was located 3.5 miles north of Stonyford and 1 mile west of Big Stony Creek (Barrett, 1908:241).

Other sorts of resources were also gathered or collected from particular areas. Obsidian was obtained from the east shore of Clear Lake, south of Sulphur Bank and about 10 miles north of Lower Lake, just south of Borax Lake (Merriam, 1967:298). Konocti Mountain was a principal source of angelica root, which was highly valued for ceremonial purposes (Kniffen, 1939:360). Shell money was made from Washington clam shells from Lower Lake (Merriam, 1967:297). Soft red stone for beads was mined from the hills northeast of Lower Lake and a brown stone was collected from some miles south of Lower Lake, at Mamking [?] Valley (Merriam, 1967:295). "Indian gold," a rare, somewhat soft, white rock used for money is found in the mountains between Lake County and Bodega Bay and on one ledge in the Lower Lake region (Lewis and Benson, 1949:76-77). One of the main fords of the Gualala River is Lalaka damali (Gifford, 1967:7). A traditional fishing place on Kelsey Creek, a mile or two upstream from Clear Lake, yielded a unique, unknown, and desirable species of fish (Kroeber, 1925:220).

In the magical realm, the hot springs at Highland Springs were believed to have medicinal qualities (Barrett, 1908:203). "Baby rocks" are of a soft, bluish gray stone resembling steatite and are believed to have magical properties to cure sterility (Barrett, 1908:165, 175-177; Barrett, 1952:385-387). Five specific locations of these rocks are mentioned: (1) 0.5 mile northeast of the schoolhouse in Bachelor Valley near Upper Lake; (2) near the old village site of Katsa'mugal on the west shore of Clear Lake; (3) in Knights Valley, 6 miles north of Hopland, at the Crawford Ranch, approximately 0.25 mile northeast of the Whistler house, situated approximately 30 yards west of the railroad tracks, 150 yards from the summit of a rocky ridge, and approximately 200 yards west of Mu'yamuya; (4) on the Elledge Ranch, approximately 8 miles southwest of Ukiah,

two rocks are located in a small valley (roughly 0.75 mile long by 0.25 mile wide) where a ranch house is located; one rock is in the middle of a country road, the other is at the edge of the valley, approximately 100 yards east; (5) at Iwi'kbe on the coast.

Indians avoid traditionally taboo places, most of which have myths associated with them. It is dangerous to hunt on the north and east sides of Mt. Kanaktai (Konocti) (Barrett, 1952:121). Two sacred rocks are feared, both located near the mouth of the Rio Garcia (Loeb, 1926:318-319). It was believed that one must run by Me'au cawa, located near the mouth of the river, or be turned into a stone. Eating mussels from *mata lakol*, in the sea near the mouth of the Rio Garcia, will produce sores on the limbs. The Ayash, a supernatural race purported to capture and kill people, live at Tenemakona (Oswalt, 1964:175-177). At Humchiwa, a group of children were reported to have been sucked into the earth (Oswalt, 1964:187-189). According to legend, the Blue Lakes are home to numerous monsters and serpents (Barrett, 1952:121; Lewis and Benson, 1949:73).

Prior to the 1870s, the dead were usually cremated unless there was a catastrophy. Barrett mentions a few burial grounds. One is located at the old Upper Lake village of Dano'xa, in a deep canyon, a short distance east of the village (Barrett, 1952:404). A large burial pit is located near the village of Co'kadjal in Ukiah Valley (Barrett, 1952:405).

Sites and areas mentioned in myths are numerous. Villages figuring in myths include Yo'butui (Barrett, 1908:185-186), Maiyi on the west side of Upper Lake Valley just north of Scott's Creek (Barrett, 1908:155), Co'samak in McDowell Valley near the head of McDowell Creek approximately 1.75 miles northeast of Sanel (Barrett, 1908:172), Kabe'l on the eastern slope of Rocky Point (Barrett, 1908:186-187), No'napotik in the eastern part of the town of Kelseyville (Barrett, 1908:197), and Dano'xa in the foothills approximately 2 miles northeast of the town of Upper Lake on the west slope of a hill overlooking the lake (Barrett, 1917:445-451). According to the myth, the people who live at Lemko'lil on the northeastern bank of Anderson Creek approximately 1 mile downstream from Boonville eat the flesh of a monster that turns them into deer (Barrett, 1908:150, 153). A brother and sister escape this fate and live at Sa'latcada (Barrett, 1908:153). Their children live on a mountain called Kano-sama in a range west of Rancheria Creek (Barrett, 1908:153). Coyote and his mother live at Flattop Rock (Oswalt, 1964:47). At Yo-butui, near Upper Lake, Coyote created men from bird feathers, later turning them into animals for misbehaving (Barrett, 1906:41, 47).

Wild Onion Mountain, or Kabai-dano, is mentioned in myth and is the site of the sweat house of Kuksu, a very powerful medicine man (Barrett, 1906:40-41). In one myth, the creator, Coyote, speaks from three mountaintops: St. Helena, Kanaktai, and a mountain near Redwood north of Ukiah (Gifford, 1939:203). Rock Pile is a prominent rocky mountain near the coast that is frequently mentioned in myth (Barrett, 1908:165). Rush Mountain figures into many myths (Oswalt, 1964). Hu'kdja, located near the north bank of McNab Creek about 2.75 miles upstream from its confluence with the Russian River, is believed to be the home of a mythical being, Huk (a birdman) (Barrett, 1908:173).

Mu'yamuya, near the west bank of the Russian River approximately 1.5 miles up from its confluence with McNab Creek, is another site named after a mythical being and held in awe (Barrett, 1908:173-174). A spring at a campsite 1.5 miles upstream from Kelseyville on the east

bank of Kelsey Creek is thought to be of mythical origin (Barrett, 1908:201-203). According to legend, a dead redwood tree near Ka'uca (on the cliff ridge between Elk and Greenwood creeks) allowed the mythical being Katca'-tca to escape from his pursuer Dano'-tca (Barrett, 1908:163). A rock dam in the creek near Kelseyville was purported to have been made by Coyote when he became angry with the fish for nipping at his ankles (Gifford, 1939:204). Today no fish live there.

Many places figure prominently in a myth in which Kah-bel, who lives on Bartlett Mountain, and Konocti, who lives on the mountain of the same name, engage in a battle over Konocti's daughter (Lewis and Benson, 1949:70-71). Both die and become parts of their respective mountains. Large boulders on the shore of Clear Lake east of Soda Bay, Soda Springs (Omarcharbe), Little Borax Lake, and Buckingham Point, all have their origins in this myth. A horse-shaped area on Konocti Mountain where trees and shrubs do not grow (today planted with walnut trees) owes its origin to a Romeo-and-Juliet-type tale (Lewis and Benson, 1949:76-77). This area is where her horse fell and died during their escape.

SALINAN

A few resource collection areas are mentioned. The "Arroyo of the Fish Weirs," so named by Crespi in 1772 because of the unusual number of weirs along the banks, is identified by Bolton as Laguinitas Creek, northeast of the Salinas River en route to San Juan Mission (Crespi, 1927:281). Acorns were harvested in the Santa Lucia Ranges, San Antonio Valley, and Nacimiento Valley (Mason, 1912).

Rancheria Tco'alamtram in the town of Cholam is said to have been the largest and most important of the San Miguel villages (Mason, 1912). Members of the bear "totem" held ceremonies at a natural amphitheater facing the ocean, called "Devil's Canyon." It was believed that fire was brought to their people at this place by a man in a "white winged boat" (Mason, 1912).

Pictographs attributed to the Salinan are located in *La Caverna Pintada*, or Painted Cave, near the top of the hills forming the east wall of the San Antonio River valley, approximately 5 miles above the San Antonio Mission (Mason, 1912).

SERRANO

The Serrano collected a white-flowered species of lobelia from the Kern plain in spring for use in a potent emetic (Merriam, 1967:437).

Kroeber mentions several sites of mythological significance (1925). Mount San Gorgonio in the north is the site of the origin of the human race (Kroeber, 1925:619). Hatauva, in Bear Valley, is where one of the creators, Kukitat, was destroyed and his heart stolen (Kroeber, 1925:619). Hatauva is also the birthplace of the progenitor of the Serrano people (Kroeber, 1925:619).

SHASTA (KONOMIHU, NEW RIVER, OKWANUCHU)

Fish dams were built across the Klamath River at the mouth of the Shasta and Scott rivers (Kroeber, 1925:294). Though no particular locations are mentioned, it should be noted that cemeteries are located at a distance from villages (Kroeber, 1925:300). At one time during the creation of the world, Mount Shasta, Old Man Mountain (near Happy Camp), and another mountain at the head of the Rogue River were all that was protruding from the ocean (Holt, 1946:326).

A cave located on a high promontory on the north side of Klamath Canyon, nearly opposite Deer Creek, is where Indians used to take refuge when pursued. Several Indians fled there during a "war" with the whites, when they were being pursued by soldiers and men from Yreka (Merriam, 1967:216).

TATAVIAM

No locational information was found for the Tataviam applicable to the CVPIA PEIS.

TOLOWA

The Tolowa live on the Smith River and use the spawning runs of silver salmon, king salmon, and steelhead (Baumhoff, 1963). A salmon dam was customarily constructed on the Smith River at a settlement called Loginotl (Kroeber, 1925:124). Sea lions were hunted at Pekwutsu (probably Northwest Seal Rock where the lighthouse now stands), a large rock 12 miles from Crescent City (Kroeber, 1925:124). The principal source of pileated woodpecker scalps, a valuable trade item and source of wealth, was a valley on the south fork of the Smith River called Big Flat approximately 30 miles inland and southeast of Crescent City (Gould, 1966:72-73).

According to Drucker, it would be nearly impossible to list every spot in Tolowa territory that had supernatural associations, so he attempts to list the more important localities and includes a map (Drucker, 1937a:228-231). Places where gambling luck can be obtained include "Buzzard Hill," "breasts-" (2 small knolls about 50 yards apart), a large boulder called "high moving" and Kwecutle't, all of which are located north of Rowdy Creek and Smith River (Drucker, 1937a:229). Additionally, gambling luck could be obtained by diving to the bottom of a large, submerged redwood stump in the eastern park of Lake Earl (Drucker, 1937a:230). Places visited for hunting luck include Bear Rock, a pool nearby, and several places in the estuary and on the coast (1937a:229-230). North of the estuary are two places with weather power (Drucker, 1937a:229). "Wood Devils" inhabit the forests and, therefore, many dangerous places are in the mountains (Drucker, 1937a:230).

Several areas associated with myths are mentioned. Among these are Yotokut, which is the center of the world, the spot where the first redwood grew and the site of the sacred sweat house associated with the annual first salmon rite (Drucker, 1937a:229-230). At Tu'tluwurc, depressions in sand hills contain three ponds, two of which are safe to bathe in for luck while the third is inhabited by an enormous serpent (Drucker, 1937a:230). The names are spelled phonetically and the map is rather approximate. The reader is referred to the original map and text for information on the location of these places.

TUBATULABAL

Coyote and Wolf are turned into rocks on Mount Whitney (Voegelin, 1935b).

WAPPO

Salt was obtained from Valley Ford in Sonoma County (Driver, 1936:187). An acorn-gathering area was located on the east side of the Russian River (Kroeber, 1925:220).

Menefee notes that Uncle Sam Mountain in Lake County was considered sacred by the Indians and only "holy" men dared ascend it (Menefee, 1873:30). Two huge boulders between Napa City and Capel Valley were also held sacred (Menefee, 1873:30).

WINTU (NORTHERN)

Salt was obtained from Hill Creek approximately 3 miles south of Cook Springs (Merriam, 1967:276). Obsidian is stolen from the mythological figure Adder at Blood Gap and the thief drops his load at Glass Mountain (Du Bois and Demetracoupoulou, 1931:305).

A graveyard of Indian "chiefs and magnates" was located near a white men's camp of the 1870s (Heizer, 1973b:6). This camp was on the west bank of the McCloud River, approximately 22 miles from Redding and 50 miles from Red Bluff (Heizer, 1973b:2).

Many places are mentioned in myths. The Coyote Cycle story notes a holy place at Dolomi (Demetracoupoulou and Du Bois, 1932:408). Coyote lives at Shasta Buttes in one story and comes into being at Stillwater in another (Du Bois and Demetracoupoulou, 1931). Many versions of the Coyote and Death story take place at Stillwater or in "Stillwater Country" (Demetracoupoulou and Du Bois, 1932). Daupaki is the home of the mythical figure of Sehinomtabat in one story and the location of a spring in another (Demetracoupoulou and Du Bois, 1932:458). The mythical figure, Dentalium, was born and raised at Mount Shasta (Du Bois and Demetracoupoulou, 1931:324). Kukup'iwit lives at Lamoine (Du Bois and Demetracoupoulou, 1931). The story of Winiwinit and Suptit mentions Flume Creek, where the first people lived (Demetracoupoulou and Du Bois, 1932:492), and Lake Tamarack/Indian Trail Lake (Demetracoupoulou and Du Bois, 1932:493). The Wintu people were "made" at a flat near Campbell Creek (Du Bois and Demetracoupoulou, 1931:290). A mythical earth lodge is "near where the moss rock at Ono is" (Du Bois and Demetracoupoulou, 1931:371). Other places mentioned in mythology include TsaraouLok, now the Trinity Cattle Company Ranch near Trinity Center (Du Bois and Demetracoupoulou, 1931:282), Lockmiller Hole near Ono (Du Bois and Demetracoupoulou, 1931:320), Samwell Cave (Merriam, 1957:42-43), and Evil Springs in Bear Valley (Merriam, 1967:278). Several places are mentioned in the Loknorharas myth (Du Bois and Demetracoupoulou, 1931:288): a spring called Pauk'aukunmem at the top of a steep ridge at Hay Gulch, a flat called Puikloriton, and a spot on the McCloud River near Campbell's Place.

Many sacred places were recognized by the Wintu. Spots of unusual configuration were attributed to the indwelling of spirits (Du Bois, 1935:79). Wimaitcaki, at Greyrocks in Stillwater, is a large limestone formation that resembles a bear hide (Du Bois, 1935:80). Another

sacred spot is a rock resembling a salmon heart located on the east bank of the McCloud River opposite the U.S. salmon hatchery (Du Bois, 1935:80). A hole in a rock on the west bank of the Sacramento River near Antler and another hole in a rock approximately 20 yards from the Pacific Highway are both considered sacred places (Du Bois, 1935:80-81).

WIYOT

No locational information for the Wiyot was obtained that is applicable to the CVPIA PEIS.

YANA, YANA-YAHI

Salt was obtained from Salt Creek (Gifford and Klimek, 1939). It was also collected as slabs near Cow Creek, 8 miles from Redding in Wintu country, and in mud from a saline swamp near the village of Wi'tc'-uman'na, east of Millville (Kroeber, 1925:336-341; Sapir and Spier, 1943:252). Salmon were taken from the Pit River, the Sacramento River, particularly at Ball's Ferry and the mouth of Battle Creek, and the south fork of Cow Creek (Gifford and Klimek, 1939:97; Sapir and Spier, 1943:246). The area around U'ntc'unaha, a village on a plain between the upper courses of Old Cow Creek and Clover Creek approximately 15 miles south of Round Mountain, is said to be rich in flint (Sapir, 1910:123). In the north, Xerophyllum for basketry was collected at a mountain near Big Bend on the Pit River (Gifford and Klimek, 1939:89). Basin Hollow is mentioned as a place where clover, seeds, and roots were gathered and grasshopper burnings were held (Sapir, 1910:107; Sapir and Spier, 1943:252).

Wa ma'rawi, located at the cone north of Battle Creek and several miles west of Shingletown, is the scene of the creation story (Sapir, 1910:76). In the myth of "Flint Boy," the flint people live at Djo'djanu, a mountain east of Buzzard's Roost (or Round Mountain) near the headwaters of Montgomery Creek (Sapir, 1910:17). Bally Mountain, 14 miles west of Redding in Wintun territory, is another significant locale in this myth (Sapir, 1910:22). Magical places in "The Theft of Fire and the Burning of the World" include P'awi, a village on Clover Creek approximately 8 miles north of Millville; K!u'wihu, a village at the north fork of Battle Creek; Baleha, a village at Mill Creek; and Eagle's village at Cip!a on a flat hill divide between Oak Run and Little Cow Creek (Sapir, 1910:31-34, 45, 47). Ba'nexa is where Young Blue Jay and Young Wildcat come from and is located on a high hill between the north and south forks of Cow Creek, 20 miles east of Millville on the Tamarack Road (Sapir, 1910:69). At one time, Coyote dwelt at Ha'udulilmauna, a village at Black Mountain (Sapir, 1910:103). Other villages of importance in myths are Luwa'iha on the north fork of Old Cow Creek approximately 25 miles east of Millville (Sapir, 1910:112), Pu'ls-veaina on the present Tamarack Road near Ba'nexa (Sapir, 1910:125), O'djinimauna on the upper course of Bear Creek (Sapir, 1910:125), Djit`p`ama'uwitc`u on the south bank of Cedar Creek near Bullskin Ridge (Sapir, 1910:126), K!a's-ip!u on a hill a short distance south of Round Mountain (Sapir, 1910:126), and Djewint`a'urik!u 2-3 miles north of the hamlet of Round Mountain (Sapir, 1910:126). Other places important in myths are I`da'lmadu, a rocky spot with a small creek just north of the "present" stage station approximately 1.5 miles south of Montgomery Creek (Sapir, 1910:126); Tc!i'yu, now known as Ball's Ferry (Sapir, 1910:68); Ha'up!uk!aina, a spot with many high rocks on the south fork of Cow Creek (Sapir, 1910:74); Tc`ap!ulxa, or Silver Lake, 8 miles south of Round Mountain (Sapir, 1910:140); K!a'`djade (sandstone place) and Cibu'pk!aimadu (sandstone rock) on Fall River near the confluence of Pit River at Fall River Mills (Sapir, 1910:155); I't'a'urik!u, Hot Springs Valley or

Big Valley (Sapir, 1910:159); Wacu'pdi, or Kosh Creek, a northern tributary of the Pit River (Sapir, 1910:160); Dirip!oha, the hot springs of Big Bend on the Pit River (Sapir, 1910:160); Djanu'nak!aina, two rocks located a short distance east of the hamlet of Montgomery Creek that are notched from grizzly biting at a deer standing on the rocks (Sapir, 1910:206); Bala'wi, a mountain north of Stillwater Creek (Sapir, 1910:216); and Hak!aleimadu, a lake near Hat Creek (Sapir, 1910:228).

Ganu'mya, the present Basin Hollow between Clover Creek and the north fork of Cow Creek, is said to be a good luck "resting area" (Sapir and Spier, 1943:246). Near the village of Ku'wiha on Battle Creek is one of the pools that a man may swim in to gain the powers of a shaman (Sapir and Spier, 1943:279). After the birth of his first child and the umbilical chord falls off, a northern Yana man goes to the base of Round Mountain and washes his hands in a spring, then sleeps for a short time on top of the mountain (Sapir and Spier, 1943:271).

Some published maps (Kroeber, 1925: Figures 30 and 32) may be of assistance in locating these places, though the significance of the places is not noted.

YUKI (HUCHNOM, COAST YUKI)

Salt was obtained from the Stonyford Pomo in trade according to Foster (1944:167). Gifford notes that Mussel Rock, or Lilem, located 3 or 4 miles south of Westport, was a source of salt (Gifford, 1939:312). This rock was visited by inland peoples as well and was a good source of mussels (Gifford, 1939:312). Seal Rock, or Lullil, off Abalone Point, was a favorite gathering place for seal and sea lions and therefore a good place to hunt them (Gifford, 1939:318-319). Sea Lion Rock, or Lilsoholli, near DeVillbiss' ranch was another hunting place, although there seems to have been a problem with sharks there (Gifford, 1939:319). Young cormorant were obtained for food at rookeries at Westport and Rockport (Gifford, 1939:321). Usal Beach in Sinkyone territory was a good place to obtain sardines (Gifford, 1939:323). It is possible that Mount Sanhedrin was the source of obsidian (Foster, 1944:208). Acorn-gathering grounds are said to be located "over the slopes behind Westport and in the bottoms of Ten Mile Run" (Kroeber, 1925:213).

Some mythologically important places are mentioned in the references consulted. In the "Coyote and the World" myth, Suk-upit (Yellow Pine Spring) is a great village south of the Middle Eel River and 1 mile east of Old Ferry, where there is a great ceremonial house and where Coyote and Jackrabbit live (Kroeber, 1932b:918-919). Militiki, in the southern foothills of Round Valley and south of Henley's ranch, is another village, where the people dance with Coyote (Kroeber, 1932b:919). When Coyote steals the sun, he finally makes it rise over MocAmpulAmlatc, a hill east of Round Valley (Kroeber, 1932b:925). In the "Thunder Twins" myth, Lalkuhtki, a pond mentioned in the "Coyote and the World" myth, is created by the sons of Thunder (Kroeber, 1932b:930).

Magical places are often the residences of creatures with power or creatures that grant power. *Mumolno'm* are conceived of as little men who give power to doctors and cause illness. Three places are recorded as homes of *mumolno'm* (Foster, 1944:205). "Eagle Noise Rock," located below the Dos Rios-Covelo road approximately 1 mile from Dos Rios, is conical shaped and considered a dance house. Round Mountain, located south of the Hop Ranch above the Eel

River, is another *mumolno'm* home; and a conical rock on the south side of the Eel River, a short distance above the Etrel Ferry, is the third. *Uksu* are water eagles or were eagles and live in the waters under the mountains. Some entrances to their home are mentioned (Foster, 1944:205): a spot several miles above Eel River Ranger Station, Willow Creek beside the road, and Lilhucos ("rock sharp"), a short distance above the Etrel crossing of the Eel River.

The Yuki are the Indians involved in the Bloody Rock legend. During a conflict with whites, a band of 30 or 40 Yuki are said to have escaped to Bloody Rock, an isolated boulder on a mountain face overlooking the Eel River Valley. Rather than be captured, they leapt to their deaths (Powers, 1877:137).

YOKUTS (FOOTHILL)

The Witchumne group of Yokuts near Lemon Cone claim to have originated on or near a big rock known as Homer's Nose, between the canyons of the east and south forks of the Kaweah River (Merriam, 1967:409).

YOKUTS (NORTHERN VALLEY)

Table Mountain is the ancient home and emblem of the Tmnah tribe of Yokuts from the south side of the San Joaquin River above Pullasky (Merriam, 1967:417-418).

YOKUTS (SOUTHERN VALLEY)

Burial grounds are mentioned in several sources. A group of ancient bodies were discovered in the Buena Vista Hills (Kroeber, 1925:499). A mass burial ground is located at Hubb on Kings River Island and is thought to represent a massacre or epidemic, and another is located on the north shore of Kern Lake (Latta, 1949:114-119). One hundred unburied skeletons were found on Skull Island (Latta, 1949:119).

Painted Cave on the south fork of the Tule River may be important to the Tule River Reservation Indians although they do not know the origin of the paintings (Curtis, 1907-1930:160; Merriam, 1967:412).

The story of Coyote and Talkakuna takes place at Chukchano, north of Apaso, Fresno flat (Curtis, 1907-1930). The old village of Halau, northwest of modern Fountain Springs, is the place where the *Lonewis*, or mourning ceremony, was held (Latta, 1949:5). Near the old village of Wuknaw, at Sueu at the north edge of Antelope Valley, is the "arena" where the animal and bird people met to discuss the creation of Indians (Latta, 1949:13).

YUROK

An acorn-gathering place is located on Blue Creek, 5 or 6 miles from the top of Oka Mountain (Spott and Kroeber, 1942:219). The primary fish weir of the Yurok was at Kepel, one of the most important villages (Curtis, 1907-1930). The most famous of the Yurok ceremonies, the Deerskin Dance, is associated with the building of the salmon dam at Kepel every autumn (Kroeber, 1925:58-60). Oliken (Erliken) is a famous salmon fishing camp near Lamb's Riffle

(Kroeber, 1945). Redding Rock, or Sekwona', is an enormous sea stack 6 miles offshore where Indians would hunt sea lions in still weather (Waterman, 1920:261). It is also the center of much myth.

The birth of the Yurok culture hero takes place at Kenek, the most frequently mentioned village in Yurok mythology (Kroeber, 1925:73). Kenek, located on the south bank of the Klamath River a few miles below its confluence with the Trinity River, is said to be the center of the Yurok world (Waterman, 1920:190). Coyote lives in a village on Kewet Mountain in the myth of "The Shinny Player of Kewet" (Curtis, 1907-1930). In the story of the Twin Sisters, they are turned into two rocks that are visible at Ishi-Pishi falls in the summer and at Mak-Harum falls in the winter (Graves, 1929:49). In the story of Big Ike, the rainmaker, he makes rain at Medicine Rock (Graves, 1929:70-71). Coyote steals fire from Thunder on top of Mount Shasta (Graves, 1929:93-95). Other places that figure prominently in Yurok mythology are Rivet Mountain and Su'mig, or Patrick's Point, where the last immortals live as dolphins (Waterman, 1920:197,256,267). Nr'rts-o-popil is a town of immortals (Waterman, 1920:264) and Qe'nek-pul is a place where immortals use an invisible ladder to the sky (Waterman, 1920:251). Pekwtsu is a rock 4 miles from Crescent City in Tolowa territory and many myths refer to this crag where a lighthouse now sits (Waterman, 1920). A rock near the village of Rummai near the convergence of the Klamath River and Bluff Creek was the home of a *Woge* (mythical person) (Spott and Kroeber, 1942:238).

Some important sites are the residences of supernatural creatures and spirits. A lake called Plu'l is on the mountain above Bluff Creek where a great inland whale lived (Spott and Kroeber, 1942:224). A supernatural being lives in the False Klamath rock (*olr'gr*), a sea stack at the south end of the cove (Waterman, 1920:230). Supernatural beings also reside at O'regos, a granite crag at the edge of a lagoon (Waterman, 1920:231), and at a small, nearly submerged sea stack called Tsra'hptsik (Waterman, 1920:232). *Me'rxkwi, tse'gwa, qeneqa's*, and *o-tse'p* are all boulders or rocks inhabited by beings who objected to death being introduced to the world (Waterman, 1920:250). A "wild devil" sits on Sugar Loaf Rock, making it a dangerous place to loiter (Waterman, 1920:238). A giant dentalium used to live at Pe'kwtel, a very long rock in a stream below the town of Pe'kwan and people pray for good luck when they pass (Waterman, 1920:243).

The Deerskin Dance originated at Petskuk, the "upriver end of the world," and the story of how it is brought downstream includes places such as Oko'nile'l at Clear Creek, Segwu' (the Karok village of Katamin), O'lege'l Camp Creek, Kepel, and Rekwoi (Kroeber and Gifford, 1949). The Deerskin Dance and the Jumping Dance were held at Weitspus (Kroeber and Gifford, 1949). The first salmon ceremony originates at the Karok village of Amaikiaram (Kroeber and Gifford, 1949). Pe'kwan is a sacred village and ceremonial center located on the banks of Pe'kwan Creek (Waterman, 1920:243). Omikyera is a dance place located at the mouth of the Salmon River (Spott and Kroeber, 1942:224). Locations of all these places can be obtained from a map in Waterman (1920). Other sites also may be included.

BIBLIOGRAPHY

The following abbreviations are used for the following references:

NA = No applicable information found
NF = Source not found
C = Information found, source cited

Aginsky, B.W.

NA 1943, Culture Element Distributions, XXIV: Central Sierra. University of California Anthropological Records, Vol. 8, No. 4, pp. 393-468.

Bancroft, H.H.

NA 1886-1890,The History of California: Vol. 4. San Francisco, The History Company.

Barrett, S.A.

C 1906, A Composite Myth of the Pomo Indians: Journal of American Folklore, Vol. 19, pp. 37-51.

C 1908, The Ethnogeography of Pomo and Neighboring Indians: University of California Publications in American Anthropology and Ethnology, Vol. 6, No. 1, pp. 1-332.

NA 1916, Pomo Buildings, in Holmes Anniversary Volume: Anthropological Essays Presented to William Henry Holmes in Honor of His 70th Birthday. Washington, J.W. Bryan Press.

NF 1917a, Ceremonies of the Pomo Indians: University of California Publications in American Anthropology and Ethnology, Vol. 12, No. 10, pp. 397-441.

NA 1917b, Pomo Bear Doctors. University of California Publications in American Anthropology and Ethnology, Vol. 12, No. 11, pp. 443-465.

C 1919, Myths of the Southern Sierra Miwok: University of California Publications in American Anthropology and Ethnology, Vol. 16, No. 1, pp. 1-28.

C 1952, Material Aspects of Pomo Culture: Bulletin of the Public Museum of the City of Milwaukee, Vol. 20, Nos. 1-2.

Barrett, S.A., and Gifford, E.W.

C 1933, Miwok Material Culture: Bulletin of the Public Museum of the City of Milwaukee, Vol. 2, No. 4, pp. 117-376.

Barrows, D.P.

C 1900, The Ethno-botany of the Coahuilla Indians of Southern California: Chicago, University of Chicago Press. Reprinted in 1967 by Malki Museum Press, Banning, California. 1967 Reprint.

Baumhoff, M.A.

NA 1958, California Athabascan Groups: University of California Anthropological Records, Vol. 16, No. 5, pp. 157-238.

C 1963, Ecological Determinants of Aboriginal California Populations: University of California Publications in American Anthropology and Ethnology, Vol. 49, No. 2, pp. 155-236.

Beals, R.L.
C 1933, Ethnology of the Nisenan: University of California Publications in American Archaeology and Ethnology, Vol. 31, No. 6, pp. 335-414.

Bean, L.J.
NA 1972, Mukat's People: The Cahuilla Indians of Southern California: Berkeley, University of California Press.

Bean, L.J., and Lawton, H.W.
NA 1965, The Cahuilla Indians of Southern California: Banning, California, Malki Museum Press.

Bean, L.J., and Lawton, H.W., comps.
NA 1967, A Bibliography of the Cahuilla Indians of California: Banning, California, Malki Museum Press.

Bean, L.J., and Saubel, K.S.
NA 1972, Diaries and Accounts of the Romero Expeditions in Arizona and California, 1823-1826: Los Angeles, W. Ritchie Press.

Bean, L.J., Vane, S.B., and Young, J.
C 1991, The Cahuilla Landscape: The Santa Rosa and San Jacinto Mountains: Menlo Park, California, Ballene Press.

Benedict, R.
NF 1924, A Brief Sketch of Serrano Culture: American Anthropologist, Vol. 26, No. 3, pp. 366-392.
NF 1926, Serrano Tales: Journal of American Folklore, Vol. 39, No. 151, pp. 1-17.

Blackburn, T.C.
NF 1962, Ethnohistoric Descriptions of Gabrielino Material Culture: Annual Reports of the University of California Archaeological Survey, Vol. 5, pp. 1-50.

Bledsoe, A.J.
NA 1881, History of Del Norte County, California: Eureka, California, Wyman. (Reprinted in 1971 by Wendy's Books, Crescent City, California).
NA 1885, Indian Wars of the Northwest: A California Sketch: San Francisco, Bacon. Reprinted in 1956 by Biobooks, Oakland.

Bright, W.
C 1954, The Travels of Coyote: A Karok Myth: The Kroeber Anthropological Society Papers 11.
C 1957, The Karok Language: University of California Publications in Linguistics 13.

Broadbent, S.M.
NA 1972,The Rumsen of Monterey: An Ethnography from Historical Sources, in Miscellaneous Papers on Archaeology, University of California Archaeological Research Facility Contributions 14.

Brown, A.K.
NF 1967, The Aboriginal Population of the Santa Barbara Channel: University of California Archaeological Survey Reports, Vol. 69, pp. 1-99.

Bruff, J.G.
NA 1949, Gold Rush: The Journals, Drawings, and Other Papers of J. Goldsborough Bruff, April 2, 1849 to July 20, 1851. G.W. Read and R. Gaines, eds. New York, Columbia University Press.

Bryant, E.
NA 1849, What I Saw in California: Being the Journal of a Tour by the Emigrant Route and South Pass of the Rocky Mountains, across the Continent of North American, the Great Desert Basin, and through California in the Years 1846-1847: Fifth edition. New York, D. Appleton.

Buffum, E.G.
C 1850, Six Months in the Gold Mines: From a Journal of Three Years Residence in Upper and Lower California, in 1847-8-9: London, R. Bentley.

Bunnell, L.H.
NA 1911, The Discovery of the Yosemite and the Indian War of 1851, Which Led to That Event [1880]: Fourth edition. Los Angeles, G.W. Gerlicher.

Callaghan, C.A.
NA 1970, Bodega Miwok Dictionary: University of California Publications in Linguistics 60.

Chapman, C.E., ed.
NA 1911, Expedition on the Sacramento and San Joaquin Rivers in 1817: Diary of Fray Narciso Duran: Publications of the Academy of Pacific Coast History, Vol. 2, No. 5, pp. 329-349.

Chesnut, V.K.
NF 1902, Plants Used by the Indians of Mendocino County, California: Contributions from the U.S. National Herbarium, Vol. 7, No. 3, pp. 295-408.

Cody, B.
NA 1941, Yurok Tales: Wohpekumen's Beads; As Told by Jane Van Stralen to Bertha P. Cody. Masterkey, Vol. 15, No. 6, pp. 228-231.
NA 1942a, Yurok Fish-Dam Dance; As Told by Jane Van Stralen to Bertha P. Cody. Masterkey, Vol. 16, No. 3, pp. 81-86.
NA 1942b, Some Yurok Customs and Beliefs: Masterkey, Vol. 16, No. 5, pp. 157-162.
NA 1943, Some Yurok Customs and Beliefs: Masterkey, Vol. 17, No. 3, pp. 81-87.

Cook, S.F.
NA 1943, The Conflict between the California Indians and White Civilization, I: The Indian Versus the Spanish Mission: Ibero-Americana 21.
NA 1955a, The Epidemic of 1830-1833 in California and Oregon: University of California Publications in American Anthropology and Ethnology, Vol. 43, No. 3, pp. 303-326.
NA 1955b, The Aboriginal Population of the San Joaquin Valley, California: University of California Anthropological Records, Vol. 16, No. 2, pp. 31-80.
NA 1956, The Aboriginal Population of the North Coast of California, University of California Anthropological Records, Vol. 16, No. 3, pp. 81-130.

Cook, S.F.
NA 1960, Colonial Expeditions to the Interior of California: Central Valley, 1800-1820: University of California Anthropological Records, Vol. 16, No. 6, pp. 239-292.
NA 1964, The Aboriginal Population of Upper California, in Proceedings of the 35th International Congress of Americanists, pp. 397-403. Three volumes. Mexico, 1962.
NA 1976, The Conflict between the California Indian and White Civilization: The American Invasion 1848-1870: Ibero-Americana 23. Berkeley, University of California Press.

Costanso, M.
NA 1910, The Narrative of the Portola Expedition, 1769-1770: A. van Hemert-Engert and F.J. Teggart, eds. Publications of the Academy of Pacific Coast History, Vol. 1, No. 4, pp. 91-159.
NA 1911, The Portola Expedition of 1769-1770: Diary of Miguel Costanso: Frederick J. Teggart, ed. Publications of the Academy of Pacific Coast History, Vol. 2, No. 4, pp. 161-327.

Coues, E., ed.
NF 1900, On the Trail of a Spanish Pioneer: The Diary and Itinerary of Francisco Garces (Missionary Priest) in His Travels through Sonora, Arizona, and California 1775-1776: Two vols. New York, Francis P. Harper.

Crespi, J.
C 1927, Fray Juan Crespi: Missionary Explorer on the Pacific Coast 1769-1774: H.E. Bolton, ed. and trans. Berkeley, University of California Press. Reprinted in 1971 by AMS Press, New York.

Curtin, J.
C 1898, Creation Myths of Primitive American in Relation to the Religious History and Mental Development of Mankind. New York, Little & Brown. Reprinted in 1969 by Benjamin Bloom, New York.

Curtis, E.S.
C 1907-1930, The North American Indian: Being a Series of Volumes Picturing and Describing the Indians of the United States, and Alaska: Vol. 14. F.W. Hodge, ed. N.p. Plimpton Press. Reprinted by Johnson Reprint, New York, 1970.

de Angulo, J.
NF 1926, The Background of the Religious Feeling in a Primitive Tribe: American Anthropologist, Vol. 28, No. 2, pp. 352-360.
C 1932, The Creation Myth of the Pomo Indians: Anthropos, Vol. 27, pp. 261-274.
C 1935, Pomo Creation Myth: Journal of American Folklore, Vol. 48, No. 189, pp. 203-262.
NA 1975, The Achumawi Life-Force: The Journal of California Anthropology, Vol. 2, No. 1, pp. 60-63. Translation of 1928 La Psychologie Religieuse des Achumawi.

de Angulo, J., and Freeland, L.S.
NA 1931, The Achumawi Language: International Journal of American Linguistics, Vol. 6, No. 2, pp. 77-120.

Delano, A.
C 1854, Life on the Plains and among the Diggings: Being Scenes and Adventures of an Overland Journey to California: Buffalo, New York, Orton and Mulligan.

Demetracopoulou, D., and Du Bois, C.A.
C 1932, A Study of Wintu Mythology: Journal of American Folklore, Vol. 45, No. 178, pp. 375-500.

Dixon, R.B.
C 1902, Maidu Myths: The Huntington California Expedition: American Museum of Natural History, Vol. XVII, Part II, pp. 33-118. New York.
C 1905, The Northern Maidu. Bulletin of the American Museum of Natural History, Vol. 17, No. 3, pp. 119-346. New York.
NA 1907, The Shasta: Bulletin of the American Museum of Natural History, Vol. 17, No. 5, pp. 381-498. New York.
C 1908a, Achomawi and Atsugewi Tales: Journal of American Folklore, Vol. 21, pp. 159-177.
NA 1908b, Notes on the Achomawi and Atsugewi Indians of Northern California: American Anthropologist, n.s., Vol. 10, No. 2, pp. 208-220.
NA 1910, The Chimariko Indians and Language: University of California Publications in American Anthropology and Ethnology, Vol. 5, No. 5, pp. 293-380.

Driver, H.E.
C 1936, Wappo Ethnography. University of California Publications in American Anthropology and Ethnology, Vol. 36, No. 3, pp. 179-220.
NA 1937, Culture Element Distributions, VI: Southern Sierra Nevada: University of California Anthropological Records, Vol. 1, No. 2, pp. 53-154.
C 1939, Culture Element Distributions, X: Northwest California. University of California Anthropological Records, Vol. 1, No. 6, pp. 297-433.

Drucker, P.
C 1937a, The Tolowa and Their Southwest Oregon Kin. University of California Publications in American Anthropology and Ethnology, Vol. 36, No. 4, pp. 221-300.
NA 1937b, Culture Element Distributions, V: Southern California: University of California Anthropological Records, Vol. 1, No. 1, pp. 1-52.

NF 1910, The Religious Practices of the Diegueno Indians: University of California Publications in American Anthropology and Ethnology, Vol. 8, No. 6, pp. 271-358.

DuBois, C.
NF 1901, The Mythology of the Dieguenos: Journal of American Folklore, Vol. 14, No. 54, pp. 181-185.
NF 1904, Mythology of the Mission Indians: Journal of American Folklore, Vol. 17, No. 66, pp. 185-188.
C 1905, The Mythology of the Dieguenos, Mission Indians of San Diego County, California, as Proving Their Status to Be Higher Than Is Generally Believed, in Proceedings of the 13th International Congress of Americanists, pp. 101-106. New York.
C 1908a, Ceremonies and Traditions of the Diegueno Indians: Journal of American Folklore,Vol. 21, pp. 228-236.
NF 1908b, The Religion of the Luiseno and Diegueno Indians of Southern California: University of California Publications in American Anthropology and Ethnology, Vol. 8, No. 3, pp. 69-186.

DuBois, C.A.
C 1935, Wintu Ethnography: University of California Publications in American Anthropology and Ethnology, Vol. 36, No. 1, pp. 1-148.
NA 1936, The Wealth Concept as an Integrative Factor in Tolowa-Tututni Culture, in Essays in Anthropology Presented to A.L. Kroeber in Celebration of His Sixtieth Birthday, pp. 49-65. R.H. Lowie, ed. Berkeley, University of California Press.
NA 1939, The 1870 Ghost Dance: University of California Anthropological Records, Vol. 3, No. 1, pp. 1-151.

DuBois, C.A., and Demetracoupoulou, D.
C 1931, Wintu Myths: University of California Publications in American Anthropology and Ethnology, Vol. 28, No. 5, pp. 279-403.

Duran, N., and Fortuny, B.
NA 1958 [Reply to the Interrogatorio of 1812, Mission San Jose.], in The History of Mission San Jose California, 1797-1835, pp. 268-276. F.F. McCarthy, ed. Fresno, Academy Library Guild.

Elmendorf, W.W.
NA 1968, Lexical and Cultural Change in Yukian: Anthropological Linguistics, Vol. 10, No. 7, pp. 1-41.

Engelhardt, Z.
NA 1908, The Missions and Missionaries of California: Four vols. San Francisco, James H. Barry.
NF 1921, San Luis Rey Mission: San Francisco, James H. Barry.
NA 1922, San Juan Capistrano Mission: Los Angeles, Standard Printing Company.
NA 1923, Santa Barbara Mission: San Francisco, James H. Barry.
NF 1927a, San Fernando Rey: The Mission of the Valley: Chicago, Franciscan Herald Press.

NA 1927b, San Gabriel Mission and the Beginnings of Los Angeles: San Gabriel, California, Mission San Gabriel.
C 1930, San Buenaventura Mission: The Mission by the Sea: Santa Barbara, California, Mission Santa Barbara.
NA 1933, Mission San Luis Obispo in the Valley of the Bears: Santa Barbara, California, Mission Santa Barbara.

Essene, F.J.
NA 1942, Culture Element Distributions, XXI: Round Valley: University of California Anthropological Records, Vol. 8, No. 1, pp. 1-97.

Fages, P.
NA 1937, A Historical, Political, and Natural Description of California, by Pedro Fages, Soldier of Spain [1775]: H.I. Priestley, trans. Berkeley, University of California Press.

Fenenga, F.
NF 1947, Preliminary Survey of Archaeological Resources in the Isabella Reservoir, Kern County, California. West Coast Projects, River Basin Surveys, Smithsonian Institution, California. Washington.

Foster, G.M.
C 1944, A Summary of Yuki Culture: University of California Anthropological Records, Vol. 5, No. 3, pp. 155-244.

Garth, T.R.
NA 1944, Kinship Terminology, Marriage Practices and Behavior toward Kin among the Atsugewi: American Anthropologist, Vol. 46, No. 3, pp. 348-361.
NA 1945, Emphasis on Industriousness among the Atsugewi: American Anthropologist, Vol. 47, No. 4, pp. 554-566.
C 1953, Atsugewi Ethnography: University of California Anthropological Records, Vol. 14, No. 2, pp. 129-212.

Gayton, A.H.
NA 1930a, Yokuts-Mono Chiefs and Shamans: University of California Publications in American Anthropology and Ethnology, Vol. 24, No. 8, pp. 361-420.
NA 1930b, The Ghost Dance of 1870 in South-Central California: University of California Publications in American Anthropology and Ethnology, Vol. 28, No. 3, pp. 57-82.
NA 1945, Yokuts and Western Mono Social Organization: American Anthropologist, Vol. 47, No. 3, pp. 409-426.
NA 1946, Culture-Environment Integration: External References in Yokuts Life: Southwestern Journal of Anthropology, Vol. 2, No. 3, pp. 252-268.
C 1948, Yokuts and Western Mono-Ethnography: University of California Anthropological Records, Vol. 10, Nos. 1-2, pp. 1-302.

Gayton, A.H., and Newman, S.S.
NA 1940, Yokuts and Western Mono-Ethnography: University of California Anthropological Records, Vol. 5, No. 1, pp. 1-110.

Gifford, E.W.
NA 1916a, Miwok Moieties: University of California Publications in American Anthropology and Ethnology, Vol. 12, No. 4, pp. 139-194.
NA 1916b, Dichotomous Social Organization in South Central California, University of California Publications in American Anthropology and Ethnology, Vol. 11, No. 5, pp. 291-296.
C 1917, Miwok Myths: University of California Publications in American Anthropology and Ethnology, Vol. 12, No. 8, pp. 283-338.
NA 1918, Clans and Moieties in Southern California: University of California Publications in American Anthropology and Ethnology, Vol. 14, No. 2, pp. 155-219.
NA 1922, Californian Kinship Terminologies: University of California Publications in American Anthropology and Ethnology, Vol. 18, No. 1, pp. 1-285.
NA 1923a, Pomo Lands on Clear Lake: University of California Publications in American Anthropology and Ethnology, Vol. 20, No. 5, pp. 77-92.
NA 1923b, The Habitat of the Wailaki: University of California Publications in American Anthropology and Ethnology, Vol. 20, No. 6, pp. 95-109.
C 1923c, Western Mono Myths, Journal of American Folklore, Vol. 36, pp. 301-367.
NA 1926a, Miwok Cults: University of California Publications in American Anthropology and Ethnology, Vol. 18, No. 3, pp. 391-408.
NA 1926b, Clear Lake Pomo Society: University of California Publications in American Anthropology and Ethnology, Vol. 18, No. 2, pp. 287-390.
C 1926c, Miwok Lineages and the Political Unit in Aboriginal California: American Anthropologist, Vol. 28, No. 2, pp. 389-401.
C 1927, Southern Maidu Religious Ceremonies: American Anthropologist, Vol. 29, No. 3, pp. 214-257.
NA 1928, The Cultural Position of the Coast Yuki: American Anthropologist, Vol. 30, No. 1, pp. 112-115.
NF 1931, The Kamia of Imperial Valley: Bureau of American Ethnology Bulletin 97. Washington.
C 1932, The Northfork Mono: University of California Publications in American Anthropology and Ethnology, Vol. 31, No. 2, pp. 15-65.
C 1939, The Coast Yuki: Anthropos, Vol. 34, pp. 292-375. Reprinted: Sacramento Anthropological Society Papers 2, Sacramento State College, Sacramento, 1965.
NA 1944, Miwok Lineages: American Anthropologist, Vol. 46, No. 3, pp. 376-381.
C 1955, Central Miwok Ceremonies: University of California Anthropological Records, Vol. 14, No. 4, pp. 216-318.
C 1967, Ethnographic Notes on the Southwestern Pomo: University of California Anthropological Records, Vol. 25, pp. 1-47.

Gifford, E.W., and Klimek, S.
C 1939, Culture Element Distributions, II: Yana: University of California Publications in American Archaeology and Ethnology, Vol. 37, No. 2, pp. 71-100.

Gifford, E.W., and Kroeber, A.L.
C 1939, Culture Element Distributions, IV: Pomo: University of California Publications in American Anthropology and Ethnology, Vol. 37, No. 4, pp. 117-254.

Goddard, P.E.
C 1903, Life and Culture of the Hupa: University of California Publications in American Anthropology and Ethnology, Vol. 1, No. 1, pp. 1-88.
NF 1904, Hupa Texts: University of California Publications in American Anthropology and Ethnology, Vol. 1, No. 2, pp. 89-368.
C 1907a, Kato Texts: University of California Publications in American Anthropology and Ethnology, Vol. 5, No. 3, pp. 65-238.
NA 1907b, Kato, in Handbook of American Indians North of Mexico, Vol. 1, p. 665. F.W. Hodge, ed. Two vols. Bureau of American Ethnology Bulletin 30. Washington.
NA 1912, Elements of the Kato Language: University of California Publications in American Anthropology and Ethnology, Vol. 11, No. 1, pp. 1-176.
C 1914a, Notes on the Chilula Indians of Northwestern California: University of California Publications in American Anthropology and Ethnology, Vol. 10, No. 6, pp. 265-288.
NA 1914b, Chilula Texts: University of California Publications in American Anthropology and Ethnology, Vol. 10, No. 7, pp. 289-379.

Goldschmidt, W.R.
C 1951, Nomlaki Ethnography: University of California Publications in American Anthropology and Ethnology, Vol. 42, No. 4, pp. 303-443.

Gould, R.A.
C 1966, The Wealth Quest among the Tolowa Indians of Northwestern California: Proceedings of the American Philosophical Society, Vol. 110, No. 1, pp. 67-89.

Grant, C.
C 1965, The Rock Paintings of the Chumash: A Study of California Indian Culture: Berkeley, University of California Press.

Graves, C.S.
C 1929, Lore and Legends of the Klamath River Indians: Yreka, California, Press of the Times.
NA 1934, Before the White Man Came: Yreka, California, The Siskiyou News.

Harrington, J.P.
C 1931, Karuk Texts: International Journal of American Linguistics, Vol. 6, No. 2, pp. 121-161.
C 1932a, Karuk Indian Myths: Bureau of American Ethnology Bulletin 107. Washington.
NA 1932b, Tobacco among the Karuk Indians of California: Bureau of American Ethnology Bulletin 94. Washington.
NA 1934, A New Original Version of Boscana's Historical Account of the San Juan Capistrano Indians of Southwest California: Smithsonian Miscellaneous Collections, Vol. 92, No. 4, pp. 1-62.
NA 1942, Culture Element Distributions XIX: Central California Coast: University of California Anthropological Records, Vol. 7, No. 1, pp. 1-46.

Harrington, J.P., and Merriam, C.H.
C 1967, Chimariko Notes, in Ethnographic Notes on California Indian Tribes, II: Ethnological Notes on Northern and Southern California Tribes, pp. 226-229. R.F. Heizer, ed. University of California Archaeological Survey Reports 68.

Harrington, M.R.
NA 1943, A Glimpse of Pomo Archaeology: Masterkey, Vol. 17, No. 1, pp. 9-12.

Heizer, R.F.
NF 1955, California Indian Linguistic Records: The Mission Indian Vocabularies of H.W. Henshaw: University of California Anthropological Records, Vol. 15, No. 2, pp. 85-202.
NF 1968, The Indians of Los Angeles County: Hugo Reid's Letters of 1852. Southwest Museum Papers 21. Los Angeles.
NA 1970, Names and Locations of Some Ethnographic Patwin and Maidu Indian Villages. University of California Archaeological Research Facility Contributions, Vol. 9, No. 5, pp. 79-118.
NF 1973a, Collected Documents on the Causes and Events in the Bloody Island Massacre of 1850: University of California Archaeological Research Facility.
C 1973b, Notes on the McCloud River Wintu and Selected Excerpts from Alexander S. Taylor's Indianology of California: University of California Archaeological Research Facility, Berkeley.
NA ed., 1978, Handbook of North American Indians. Volume 8: California. Smithsonian Institution. Washington.

Heizer, R.F., and Hester, T.R.
NF 1970a, Some Early Treaties with California Indians; Document 3a, "Treaty between the Americans and the Indians on the 'Sonoma Frontier', 1848." University of California Archaeological Research Facility Contributions, Vol. 9, No. 5, pp. 107-111.
NA 1970b, Shasta Villages and Territory. University of California Archaeological Research Facility Contributions, Vol. 9, No. 6, pp. 119-158.

Henshaw, H.W.
NA 1890, A New Linguistic Family in California: American Anthropologist, Vol. 3, No. 1, pp. 45-49.

Henshaw, H.W., and Kroeber, A.L.
NA 1910, Salinan Family, in Vol.2 of Handbook of American Indians North of Mexico. F.W. Hodge, ed. Two vols. Bureau of American Ethnology Bulletin 30. Washington.

Hill, D.J.
NF 1970, Collection of Maidu Indian Folklore of Northern California. Durham, California, Northern California Indian Association.

Hittell, J.S.
NF 1885-1887, History of California: Vol. 2. San Francisco, Pacific Press Publishing Company.

Hoffman, W.J.
NF 1885, Hugo Reid's Account of the Indians of Los Angeles County, California. Bulletin of the Essex Institute, Vol. 17, Nos. 1-3, pp. 1-35.

Holt, C.
C 1946, Shasta Ethnography: University of California Anthropological Records, Vol. 3, No. 4, pp. 299-349.

Hooper, L.
C 1920, The Cahuilla Indians: University of California Publications in American Anthropology and Ethnology, Vol. 16, No. 6, pp. 316-380.

Hubbard, L.
NA 1861, Notes on the Tututni, in The Indianology of California, p. 38. A.S. Taylor, ed. The California Farmer, Installment 38.

Johnston, B.E.
C 1962, Californias Gabrielino Indians (Frederick Webb Hodge Anniversary Publication Fund 8): Los Angeles, Southwest Museum.

Klimek, S.
NA 1935, Culture Element Distributions, I: The Structure of California Indian Culture: University of California Publications in American Anthropology and Ethnology, Vol. 37, No. 1, pp. 1-70.

Kniffen, F.B.
C 1928, Achomawi Geography: University of California Publications in American Anthropology and Ethnology, Vol. 23, No. 5, pp. 297-332.
C 1939, Pomo Geography: University of California Publications in American Anthropology and Ethnology, Vol. 36, No. 6, pp. 353-400.

Kroeber, A.L.
NF 1906, Two Mythos of the Mission Indians of California: Journal of American Folklore, Vol. 19, No. 75, pp. 309-321.
NA 1907a, Indian Myths of South Central California: University of California Publications in American Anthropology and Ethnology, Vol. 4, No. 4, pp. 176-250.
NF 1907b, The Yokuts Language of South Central California: University of California Publications in American Anthropology and Ethnology, Vol. 2, No. 5, pp. 165-377.
NA 1908a, A Mission Record of the California Indians: University of California Publications in American Anthropology and Ethnology, Vol. 8, No. 1, pp. 1-27.
NA 1908b, Ethnography of the Cahuilla Indians: University of California Publications in American Anthropology and Ethnology, Vol. 8, No. 2, pp. 29-68.
NA 1910, Yurok, in Handbook of American Indians North of Mexico: Vol. 2, p. 1013. F.W. Hodge, ed. Two vols. Bureau of American Ethnology Bulletin 30. Washington.
NA 1911, The Languages of the Coast of California North of San Francisco: University of California Publications in American Anthropology and Ethnology, Vol. 9, No. 3, pp. 273-435.

NA 1917, California Kinship Systems: University of California Publications in American Anthropology and Ethnology, Vol. 12, No. 9, pp. 339-396.

C 1925, Handbook of the Indians of California: Bureau of American Ethnology Bulletin 78. Washington.

C 1928a, A Kato War, in Festschrift Publication d'Hommage offerte au P. W. Schmidt. W. Koppers, ed. Mechitharisten-Congregation-Buchdruckerei, Vienna. Reprinted in 1960 by R. Heizer and M. Whipple. Berkeley, University of California Press.

NF 1928b, Law of the Yurok Indians, in Proceedings of the 22nd International Congress of Americanists, Vol. 2, p. 511-516. Two vols. Rome.

C 1929, The Valley Nisenan: University of California Publications in American Archaeology and Ethnology, Vol. 24, No. 4, pp. 253-290.

C 1932a, The Patwin and Their Neighbors: University of California Publications in American Archaeology and Ethnology, Vol. 29, No. 4, pp. 253-423.

C 1932b, Yuki Myths: Anthropos, Vol. 27, Nos. 5-6, pp. 905-939.

NF 1934, Yurok and Neighboring Kin Term Systems: University of California Publications in American Anthropology and Ethnology, Vol. 35, No. 2, pp. 15-22.

NA 1939, Local Ethnographic and Methodological Inferences, in Culture Element Distributions, X: Northwest California, pp. 425-429. H.E. Driver, ed. University of California Anthropological Records, Vol. 1, No. 6.

C 1945, A Yurok War Reminiscence: The Use of Autobiographical Evidence. Southwestern Journal of Anthropology, Vol. 1, No. 3, pp. 318-332.

Kroeber, A.L.

NA 1957, The California Indian Population about 1910, in Ethnographic Interpretations 1-6, pp. 218-225. University of California Publications in American Anthropology and Ethnology, Vol. 47, No. 2.

Kroeber, A.L., and Barrett, S.A.

C 1960, Fishing among the Indians of Northwestern California: University of California Anthropological Records, Vol. 21, No. 1, pp. 1-210.

Kroeber, A.L., and Gifford, E.W.

C 1949, World Renewal: A Cult System of Native Northwest California: University of California Anthropological Records, Vol. 13, No. 1, pp. 1-156.

Kroeber, A.L., and Heizer, R.F.

NA 1970, Continuity of Indian Population in California from 1770/1848 to 1955, in Papers on California Ethnography, pp. 1-22. University of California Archaeological Research Facility Contributions 9.

Kroeber, T.

NA 1961, Ishi in Two Worlds: A Biography of the Last Wild Indian in North American: Berkeley, University of California Press.

Latta, F.F., ed.

C 1949, Handbook of Yokuts Indians: Bakersfield, California, Kern County Museum.

Lewis, R., and Benson, C.
C 1949, Stories and Legends of Lake County: Santa Rosa, California, Press Democrat.

Loeb, E.M.
C 1926, Pomo Folkways: University of California Publications in American Anthropology and Ethnology, Vol. 19, No. 2, pp. 149-405.
C 1932, The Western Kuksu Cult: University of California Publications in American Anthropology and Ethnology, Vol. 33, No. 1, pp. 1-137.
C 1933, The Eastern Kuksu Cult: University of California Publications in American Archaeology and Ethnology, Vol. 33, No. 2, pp. 139-232.

Loud, L.L.
NA 1918, Ethnogeography and Archaeology of the Wiyot Territory: University of California Publications in American Anthropology and Ethnology, Vol. 14, No. 3, pp. 221-436.

McKern, W.C.
NA 1922, Functional Families of the Patwin: University of California Publications in American Anthropology and Ethnology, Vol. 13, No. 7, pp. 235-258.
NA 1923, Patwin Houses: University of California Publications in American Anthropology and Ethnology, Vol. 20, No. 10, pp. 159-171.

Mason, J.A.
C 1912, The Ethnology of the Salinan Indians: University of California Publications in American Anthropology and Ethnology, Vol. 10, No. 4, pp. 97-240.
NF 1918, The Language of the Salinan Indians: University of California Publications in American Anthropology and Ethnology, Vol. 14, No. 1, pp. 1-154.

Mayfield, T.J.
NF 1929, San Joaquin Primeval, Uncle Jeff's Story: A Tale of a San Joaquin Valley Pioneer and His Life with the Yokuts Indians: F.F. Latta, ed. Tulare, California, Tulare Times Press.
C 1967, Ethnographic Notes on California Indian Tribes. R.F. Heizer, ed. Three parts. University of California Archaeological Survey Reports 68.

Menefee, C.A.
C 1873, Historical and Descriptive Sketch Book of Napa, Sonoma, Lake and Mendocino [Counties] Comprising Sketches of Their Topography, Productions, History, Scenery and Peculiar Attraction: Napa City, California, Reporter Publishing House.

Menzies, A.
NF 1924, Menzies' California Journal [1792]: Quarterly of the California Historical Society, Vol. 2, pp. 265-340. San Francisco.

Merriam, C.H.
NA 1907, Distribution and Classification of the Mewan Stock in California: American Anthropologist, n.s., Vol. 9, No. 2, pp. 338-357.
NA 1916, Indian Names in the Tamalpais Region: California Out-of-Doors, April, pp. 118.

NA 1926, The Classification and Distribution of the Pit River Tribes of California: Smithsonian Miscellaneous Collections, Vol. 78, No. 3, pp. 1-52.
NF 1930a, Little Known Tribes of the Salmon, New, and Trinity Rivers in Northwestern California: Journal of the Washington Academy of Sciences, Vol. 20, No. 8, pp. 148-149.
NA 1930b, The New River Indians Tlo-hom-tah-hoi: American Anthropologist, Vol. 32, No. 2, pp. 280-293.
NA 1955, Studies of California Indians: The Staff of the Department of Anthropology of the University of California, eds. Berkeley, University of California Press.
C 1957, Wintoon Indians: University of California Archaeological Survey Reports, Vol. 38, pp. 40-43.
C 1967, Ethnographic Notes on California Indian Tribes. R.F. Heizer, ed. Three parts. University of California Archaeological Survey Reports 68.
NA 1968, Village Names in Twelve California Mission Records: R.F. Heizer, ed. University of California Archaeological Survey Reports 74.

Neasham, E.A.
C 1957, Fall River Valley, a History: Fall River Mills, California.

Nomland, G.
NA 1935, Sinkyone Notes: University of California Publications in American Anthropology and Ethnology, Vol. 36, No. 2, pp. 149-178.
C 1938, Bear River Ethnography: University of California Anthropological Records, Vol. 2, No. 2, pp. 91-124.

Nomland, G.A., and Kroeber, A.L.
NA 1936, Wiyot Towns: University of California Publications in American Anthropology and Ethnology, Vol. 35, No. 5, pp. 39-48.

O'Neale, L.M.
NA 1932, Yurok-Karok Basket Weavers: University of California Publications in American Anthropology and Ethnology, Vol. 32, No. 1, pp. 1-184.

Olmsted, D.L.
NA 1966, Achumawi Dictionary: University of California Publications in Linguistics 45.

Oswalt, R.L.
C 1964, Kashaya Texts: University of California Publications in Linguistics 36.

Palmer, L.
NA 1880, History of Mendocino County, California: San Francisco, Alley & Bowen.

Palou, F.
NA 1924 [Description of the Indians in the Vicinity of Mission San Francisco, 1776], in Vol. 2 of San Francisco or Mission Dolores, by Z. Engelhardt. Chicago, Franciscan Herald Press.

NA 1926, Historical Memoirs of New California: H.E. Bolton, ed. Four vols. Berkeley, University of California Press.
NA 1930a, Palou's Diary of the Expedition to San Francisco Bay [1774], in Vol. 2 of Anza's California Expeditions, by H.E. Bolton. Berkeley, University of California Press.
NA 1930b, Palou's Account of the Founding of San Francisco [1776], in Vol. 3 of Anza's California Expeditions, by H.E. Bolton. Berkeley, University of California Press.

Patencio, F.
C 1943, Stories and Legends of the Palm Springs Indians: M. Boynton, ed. Los Angeles, Times Mirror Co.

Pickering, C.
NA 1848, The Races of Man and Their General Distribution. Vol. 6 of United States Exploring Expedition. Philadelphia, C. Sherman.

Powers, S.
C 1877, Tribes of California: Contributions to North American Ethnology 3. Washington, DC, U.S. Geographical and Geological Survey of the Rocky Mountain Region.

Radin, P.
NA 1929, A Grammar of the Wappo Language: University of California Publications in American Anthropology and Ethnology, Vol. 27, pp. 1-194.

Riddell, F.A.
C 1968, Ethnogeography of Two Maidu Groups: Masterkey, Vol. 42, No. 2, pp. 45-52.

Rodgers, B.T., and Gayton, A.H.
NA 1944, Twenty-seven Chukchansi Yokuts Myths: Journal of American Folklore, Vol. 57, No. 225, pp. 190-207.

Sapir, E.
NA 1908, Luck-Stones among the Yana: Journal of American Folklore, Vol. 21, No. 80, p. 42.
C 1910, Yana Texts, together with Yana Myths: Collected by R.B. Dixon. University of California Publications in American Anthropology and Ethnology, Vol. 9, No. 1, pp. 1-235.
NA 1918, Yana Terms of Relationship: University of California Publications in American Anthropology and Ethnology, Vol. 13, No. 4, pp. 153-173.

Sapir, E., and Spier, L.
C 1943, Notes on the Culture of the Yana: University of California Anthropological Records, Vol. 3, No. 3, pp. 239-298.

Sawyer, J.O.
NF 1964, The Implications of Spanish /r/ and /rr/ in Wappo History: Romance Philology, Vol. 18, No. 2, pp. 165-177.

NA 1965, English-Wappo Vocabulary: University of California Publications in Linguistics 43.

Schenck, W.E.
NA 1926, Historic Aboriginal Groups of the California Delta Region: University of California Publications in American Anthropology and Ethnology, Vol. 23, No. 2, pp. 123-146.

Schenk, S.M., and Gifford, E.W.
NA 1952, Karok Ethnobotany: University of California Anthropological Records, Vol. 13, No. 6, pp. 377-392.

Sparkman, P.S.
C 1908a, The Culture of the Luiseno Indians: University of California Publications in American Anthropology and Ethnology, Vol. 8, No. 4, pp. 187-234.
NF 1908b, A Luiseno Tale, in Notes on California Folklore: Journal of American Folklore, Vol. 21, No. 80, pp. 35-36.

Spier, L.
NF 1923, Southern Diegueno Customs: University of California Publications in American Anthropology and Ethnology, Vol. 20, No. 16, pp. 295-358.

Spott, R., and Kroeber, A.L.
C 1942, Yurok Narratives, University of California Publications in American Anthropology and Ethnology, Vol. 35, No. 9, pp. 143-256.

Stewart, O.C.
NA 1943, Notes on Pomo Ethnogeography: University of California Publications in American Anthropology and Ethnology, Vol. 40, No. 2, pp. 29-62.

Strong, W.D.
NF 1929, Aboriginal Society in Southern California: University of California Publications in American Anthropology and Ethnology, Vol. 26, No. 1, pp. 1-358.

Voegelin, C.F.
NA 1935a, Tubatulabal Grammar: University of California Publications in American Anthropology and Ethnology, Vol. 34, No. 2, pp. 55-190.
C 1935b, Tubatulabal Texts: University of California Publications in American Anthropology and Ethnology, Vol. 34, No. 3, pp. 191-246.
NA 1942, Culture Element Distributions, XX: Northeast California: University of California Anthropological Records, Vol. 7, No. 2, pp. 47-252.

Voegelin, E.
NF 1938, Tubatulabal Ethnography: University of California Publications in American Anthropology and Ethnology, Vol. 2, No. 1, pp. 1-84.

Wallace, W.J.
NA 1963, The Hupa Indians of Northwestern California, in The Native Americans, pp. 232-242. R.F. Spencer et al., eds. New York, Harper and Row.

Waterman, T.T.
NF 1910, The Religious Practices of the Diegueno Indians: University of California Publications in American Anthropology and Ethnology, Vol. 8, No. 6, pp. 271-358.
C 1920, Yurok Geography: University of California Publications in American Anthropology and Ethnology, Vol. 16, No. 5, pp. 177-314.
NA 1922, All Is Trouble along the Klamath, in American Indian Life, pp. 289-296. E.C. Parsons, ed. New York, B.W. Huebsch.

Williams, E.L.
NF 1890, Narrative of a Mission Indian, in The History of Santa Cruz County, California, by E.S. Harrison. San Francisco, Pacific Press.

Wollesen, O.
NA 1972, The Aboriginal Salinan Indians: Lockwood, California, n.p.

Work, J.
NA 1945, Fur Brigade to the Bonaventura: John Work's California Expedition, 1832-1833, for the Hudson's Bay Company. A.B. Mahoney, ed. San Francisco, California Historical Society.

Yount, G.C.
NA 1966, Indians of the Napa Valley, in George C. Yount and His Chronicles of the West, Comprising Extracts from his "Memoirs" and from the Orange Clark "Narrative." C.L. Camp, ed. Denver, Colorado, Old West Publishing Company.

CENTRAL VALLEY PROJECT IMPROVEMENT ACT
PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

DRAFT TECHNICAL APPENDIX

Delta as a Source of Drinking Water

September 1997

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LIST OF ABBREVIATIONS AND ACRONYMS

BAT	best available technology
CDC	Center for Disease Control
cfs	cubic feet per second
CUWA	California Urban Water Agencies
CVP	Central Valley Project
DBP	disinfection by-product
D/DBP	disinfectant/disinfection by-product
DHS	Department of Health Services
DWR	Department of Water Resources
EPA	U.S. Environmental Protection Agency
HAA	haloacetic acid
IOC	inorganic contaminant
MCL	maximum contaminant level
MCLG	maximum contaminant level goals
mgd	million gallons per day
MWD	Metropolitan Water District
NIPDWR	National Interim Primary Drinking Water Regulations
NPDWR	National Primary Drinking Water Regulations
NSDWR	National Secondary Drinking Water Regulations
Reg-Neg	regulatory negotiations
SDWA	Safe Drinking Water Act
SMF	Standardized Monitoring Framework
SOC	Synthetic Organic Contaminant
SWP	State Water Project
SWTR	Surface Water Treatment Rule
TCR	Total Coliform Rule
TDS	total dissolved solids
THM	trihalomethane
TT	treatment technique
TTHM	total trihalomethane
TTHMFP	total trihalomethane formation potential
TOC	total organic carbon
VOC	volatile organic contaminant

CHAPTER I

INTRODUCTION

Chapter I

INTRODUCTION

The Draft Programmatic Environmental Impact Statement (PEIS) summarizes the evaluation of the direct and indirect impacts of implementing a wide range of actions identified in the Central Valley Project Improvement Act (CVPIA). Details of the information used in the definition of the affected environment and analysis of the environmental consequences are presented in the technical appendices of the Draft PEIS.

This technical appendix presents a summary of background information on the water quality of the Delta as a source of drinking water that was used during the PEIS preparation and the results of the impact analyses.

The analysis of Delta water quality was primarily based upon changes in salinity as described in the Fish Habitat and Water Quality Attachment to the Fisheries Technical Appendix.

The assumptions and results of the analyses for Alternatives 1, 2, 3, and 4 are presented in this technical appendix and summarized in the Draft PEIS. The assumptions and results of the analyses for Supplemental Analyses 1a through 1i, 2a through 2d, 3a, and 4a are summarized only in the Draft PEIS. The assumptions related to the Delta water quality analyses for Alternatives 1, 2, 3, and 4 are presented in Table I-1. The results of the analyses are presented in Table I-2.

TABLE I-1

SUMMARY OF ASSUMPTIONS FOR DELTA AS A SOURCE OF DRINKING WATER ANALYSES

Alternative or Supplemental Analysis	Assumption
No-Action Alternative	No changes to Safe Drinking Water Act requirements. New discharges to receiving waters would not increase mass loading per Regional Water Quality Control Board objectives. New water intakes would not affect Delta water quality.
1	Changes in organic constituents discharged from agricultural areas proportional to changes in irrigated acreage.
2	Same as Alternative 1.
3	Same as Alternative 1.
4	Same as Alternative 1.

TABLE I-2

SUMMARY OF IMPACT ASSESSMENT OF DELTA AS A SOURCE OF DRINKING WATER

Affected Factors	No-Action Alternative	Alternative 1	Alternative 2	Alternative 3	Alternative 4
		Change from No-Action Alternative			
Salinity and Organic Chemicals	Slightly decreased salinity as compared to existing conditions due to recent implementation of the Bay-Delta Plan Accord	Similar to the No-Action Alternative	Benefit: Improved water quality over Alternative 1 due to increased Delta inflows and associated reduction in salinity	Similar to No-Action Alternative	Benefit: Improved water quality over Alternatives 1 and 2 due to increased Delta inflows and associated reduction in salinity

CHAPTER II

AFFECTED ENVIRONMENT

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Chapter II

AFFECTED ENVIRONMENT

INTRODUCTION

This chapter describes recent water quality conditions and concerns in the Delta, sources and upstream activities contributing to Delta water quality concerns, and their ramifications for public health and water utilities. Water quality rules and regulations that pertain to Delta water quality are also discussed.

RECENT CONDITIONS

For drinking water, disinfection by-products (DBPs) have only been consistently measured since the early 1980s, as the U.S. Environmental Protection Agency (EPA) first adopted a maximum contaminant level (MCL) for trihalomethanes (THMs) in 1981. Therefore, the data presented in this technical appendix are from the early 1980s through 1996.

The Sacramento-San Joaquin Delta provides drinking water for about 20 million people. Water flowing into the Delta from the Sacramento, San Joaquin, and other river systems is used for urban and agricultural use, recreation, and navigation, and wildlife and fisheries. Part of the water is exported from the Delta by the State Water Project (SWP), the Central Valley Project (CVP), and local municipalities. Water flowing though the Delta is also diverted by industries located in the Delta and more than 1,800 agricultural diversions. Freshwater not used in the Delta or not exported from the Delta flows to the Pacific Ocean through San Francisco Bay which support wildlife and fisheries. Freshwater outflows also prevent saline water from encroaching into the Delta and degrading water quality.

WATER QUALITY CONCERNS

Water in the Sacramento-San Joaquin Delta generally meets public water supply water quality standards identified by the EPA and the California Department of Health Services. However, stricter federal standards to be promulgated within three to five years will be significantly more difficult and costly to meet. The standards of concern relate to DBPs and the potential requirements for more rigorous disinfection. In addition, the standard for arsenic, which is found naturally in Delta waters, is under evaluation for being lowered.

A number of factors affect Delta water quality. Saline water intrudes into the Delta because of the interaction of tidal action, freshwater outflow and diversions, and atmospheric conditions. Municipal and industrial treated effluent, and agricultural return flows and drainage also are discharged to the Delta. Agricultural drainage is of particular concern because the peat soils of the Delta contribute organic chemicals to the agricultural drainage water. Delta island agricultural drainage in 1987 contributed up to 45 percent of the organic THM precursors (organic chemicals in raw water which contribute to the formation of THMs during the disinfection process) during

April to August and more than 50 percent during the winter leaching period (California Department of Water Resources [DWR], 1991).

Upstream Activities

Organic materials enter the water from the following sources in the Delta in decreasing order of amounts:

- natural materials, vegetation, and organics in soils
- agriculture, as vegetative organics in drainage
- urban runoff
- municipal and industrial wastewater discharges
- pesticides and herbicides

Delta Activities

Delta conditions that contribute to the presence of THM precursor compounds in Delta water are seawater intrusion, contributing bromide, agricultural drainage, wastewater discharges to the Delta, and decay of algae and other aquatic and emergent vegetation.

Seawater Intrusion and Bromide. Most of the Delta islands are as much as 10 to 15 feet below mean tide level. Tides in the Delta not only threaten the protecting levees, but bring periodic intrusion of seawater, which mixes with the inflowing Delta freshwater. Tidal currents created by the rise and fall of sea levels modify stream flow, particularly when outflows are low or when tides are high (DWR, 1989). Intruded seawater is a major source of bromide, particularly in the western Delta. Bromide is a naturally occurring salt ion (halogen) of seawater origin and reacts with disinfectants to form DBPs. Thus, intrusion profoundly affects Delta water withdrawn at the Contra Costa Water District, SWP, and CVP intakes.

Seawater is the principal source of bromide in the Delta. Data for 1990 show that 84 to 98 percent of bromide in the California Aqueduct was of seawater origin. During that year, bromide in the Sacramento River measured at Greene's Landing, upstream of the Delta, ranged from 0.010 to 0.044 milligram per liter (mg/l). At Banks Pumping Plant, measured levels of bromide concentrations ranged from 0.250 to 0.580 mg/l in some months, up to 58 times the Sacramento River concentrations (DWR, 1991).

The presence of bromide in a drinking water source complicates the disinfection process. As with chlorine, bromide forms THMs in the chlorination process and these brominated THMs are also toxic to human health. Bromide is about twice as heavy as chlorine, and the THM standard is based on weight. Hence, it takes fewer molecules of brominated THMs to exceed the drinking water standard. Current EPA statements suggest that bromine compounds may be 100 times more dangerous than chlorine compounds. Another method of disinfection, ozone treatment, is also complicated by the presence of bromide because it forms bromate, another undesirable DBP.

Delta Soils. The central Delta, or Delta Lowlands, is characterized by highly organic, peaty soils, while the Delta margin, or Delta uplands, contains mainly mineral soils, with varying amounts of peat near the central areas. The mineral soils were developed from valley plain

materials and represent a transition between the organic soils of the river Delta basin and the better drained soils of the alluvial fans and valley floor.

Peat soils of great thickness in the wetland Delta were formed over millions of years. Peat formed from deposited sediment combined with decaying wetland plant material (particularly tule or bulrush). As recently as 150 years ago, the Delta was a vast tule marsh with dense stands of this plant. Despite substantial oxidation of the soils following drainage, the peat is still up to 60 feet in thickness in certain areas and covers a majority of the Delta land. Of the agricultural land acreage in the Delta, 80 percent contain peat soils and only 20 percent have mineral soils. The organic content of peat soil is 50 to 80 percent, while intermediate organic type soils have 30 to 50 percent organic matter. The upland soils contain 10 to 20 percent organics.

High organic content makes peat soil highly productive for agriculture, but prone to wind erosion and subsidence. Subsidence is the result of exposure of peat to oxygen, which converts the organic carbon solids to carbon dioxide gas and aqueous carbon. As a result of subsidence, the majority of the Delta land surface now lies near or below sea level.

Agriculture Activities. More than 520,000 acres, or approximately 70 percent, of the watershed draining to the Delta is used for agriculture. Water is supplied through approximately 1,800 agricultural diversions in Delta channels. During the peak summer irrigation season, diversions from these facilities collectively exceed 4,000 cubic feet per second (cfs). Principal crops are corn, grain and hay, sugar beets, alfalfa, pasture, tomatoes, asparagus, fruit, and safflower and nuts. Agricultural return flows from the irrigated areas may contain salts, THM precursors, and pesticides, all of which affect Delta water. Depending upon the crop, pre-irrigation generally occurs in the fall through spring months and irrigation generally occurs in the spring and summer months. Agricultural return flows occur during both summer and winter, with primary return flow occurring in July and August, the summer crop irrigation period. Winter return flows are highest during December and January, primarily because of precipitation. During this period, additional water is applied to leach accumulated salts from the soils.

Concentrations of water quality constituents vary seasonally with water application patterns. Concentrations can be elevated under summer low-flow conditions because of reduced dilutions and dispersions in the Delta. In winter, additional water applied to leach salts from Delta islands also increases concentrations of salts and THM precursors. Delta island drainage in 1987 contributed up to 45 percent of the organic THM precursors in Delta waters during April through August and more than 50 percent during the winter leaching period (DWR, 1990).

Crops grown in the Delta may affect the organic loading of agricultural drainage due to organic materials flushed out of peat soils by the irrigation and leaching each requires. Variations in concentration or loading in drainage from crops may be related to their individual irrigation requirements and patterns and their salinity tolerances and the amount of leaching required for satisfactory yields on these soils.

Wastewater Discharges. Discharges from municipal wastewater treatment facilities or from industrial sites often contain organic chemicals. In 1988, the Delta watershed (including the Sacramento River and San Joaquin River watersheds) had 94 municipal dischargers, which discharged an average of 256 million gallons per day (mgd) (Brown and Caldwell, 1989). In

the same year, 120 Delta watershed industrial dischargers discharged an average of 112 mgd. Municipal and industrial discharges together represented 1.5 percent of the average annual flow into the Delta.

Discharges from municipal wastewater treatment facilities and industrial sites often contain organic chemicals, and there is a strong correlation between concentration of total organic carbon (TOC) and total THM formation potential (TTHMFP). Although there is no EPA standard for TTHMFP, Standard Methods indicate that concentrations in typical surface waters range from 100 to 400 mg/l. Recent studies suggest the TTHMFP from the effluent of wastewater treatment plants upstream of the Delta range from 110 to 320 mg/l (DWR, 1991), which is within the typical range for surface water. However, analytical detection has changed dramatically during the period these studies were completed and analytical methods for TTHMFP measurement vary widely. Based on this comparison, the small percentage of total flow into the Delta that is represented by municipal and industrial discharges is probably not a major TTHMFP loading source.

Information on industrial discharge of organic constituents and synthetic organic compounds is unavailable. But because their flow contributions are small compared to municipal (less than half) and a fraction of total Delta inflow, these effluents are unlikely to contribute significant TTHMP loading.

Plant Materials. Decaying plant materials in the channels and algae blooms contribute THM precursors to the Delta, as may soils of the river channels. Currently there is no direct means of determining the relative contribution from these in-channel sources.

HEALTH EFFECTS OF CONTAMINANTS IN WATER

Microbiological organisms of principal concern as agents of disease or indicators of potential contamination in drinking water are the following:

- coliform bacteria
- viruses
- parasites

Microbial agents have been responsible for waterborne outbreaks of infectious disease. Their presence in raw waters has been a principal thrust of water treatment technology. With alternative disinfectants being considered for controlling organics, control of microorganisms should not be sacrificed in an effort to control organics. Waterborne diseases still occur in the United States. The Center for Disease Control (CDC) and EPA have estimated 1 million cases of illness per year and 1000 deaths per year due to waterborne diseases.

Bacteria

Principal waterborne bacterial agents that cause human intestinal disease are summarized in Table II-1. Rather than analyze each of these pathogenic bacteria, water utilities routinely monitor for total and fecal coliform bacteria, an indicator organism. With few exceptions, these organisms, which originate in the intestinal tract of warm-blooded animals and other sources, are

not pathogenic. Because coliforms are more abundant than pathogens in human waste by several orders of magnitude, the tests provide a margin of safety against pathogens. If coliforms are not detected, it is believed that bacterial pathogens would not be present, or at least they are likely to be below the levels known to infect. Although the tests have limitations, they are still the most widely used indicators of bacterial water quality.

TABLE II-1

PRINCIPAL WATERBORNE BACTERIAL AGENTS AND ASSOCIATED HEALTH EFFECTS

Bacteria	Disease
Salmonella typhi	Typhoid fever
Salmonella paratyphi-A	Paratyphoid fever
Salmonella (other species)	Salmonellosis, enteric fever
Shigella dysenteriae, S. flexneri, and *S. sonnei*	Bacillary dysentery
Vibrio cholerae	Cholera
Leptospira sp.	Leptospirosis
Yersinia enterocolitica	Gastroenteritis
Francisella tularensis	Tularemia
Escherischia coli (specific enteropathogenic strains)	Gastroenteritis
Pseudomonas aeroginosa	Various infections
Enterobacteriacae (Edwardsiella, Proteus, Serratia, Bacillus)	Gastroenteritis
Campylobacter	Gastroenteritis

Viruses

In contrast to bacteria, enteric viruses are always assumed to be pathogenic. The prevailing theory is that only one infective unit (which may be as low as one virus) can cause infection. Because clinical symptoms are not always manifested and the link to a waterborne source is not easy, given difficulties in detecting viruses and considering that people are exposed to viruses from many sources, the extent of waterborne diseases due to viruses is not well quantified. The CDC estimates that of the 1 million of cases per year of illness from waterborne microorganisms, perhaps more than 50 percent are viral.

Viruses of concern in drinking water are listed in Table II-2. The enteroviruses (polio, Coxsackie A, Coxsackie B, and echoviruses), adenoviruses, reoviruses, the hepatitis viruses, and rotavirus can be detected by laboratory cell culture techniques. The norwalk agent cannot be detected by laboratory cell culture techniques.

TABLE II-2

ENTERIC VIRUSES AND THEIR ASSOCIATED DISEASES

Virus Group	Number of Types	Common Disease Syndromes
Enteroviruses		
Polioviruses	3	Poliomyelitis, aseptic meningitis
Coxsackieviruses A	23	Herpangina, asepticmeningitis, exanthem
Coxsackieviruses B	6	Aseptic meningitis, epidemic myalgia, myocarditis, pericarditis
Echoviruses	31	Aseptic meningitis, exanthem, gastroenteritis
Adenoviruses	31	Upper respiratory illness, pharyngitis, conjunctivitis
Reoviruses	3	Upper respiratory illness, diarrhea, exanthem
Hepatitis viruses		
Hepatitis A Virus	1	Viral hepatitis type A or infectious hepatitis
Hepatitis B Virus	4	Viral hepatitis type B or serum hepatitis
Rotavirus	2	Gastroenteritis
Norwalk agent	1	Gastroenteritis

Parasites

Eggs and cysts of parasitic protozoa and helminths (worms) excreted into the environment may enter water supplies. All can severely disrupt the intestinal tract. Two of these are *Giardia lamblia* and *Cryptosporidium*. Their cysts/oocysts are far more resistant to disinfectants than bacteria or most viruses.

Giardia lamblia. *Giardia lamblia*, the intestinal protozoan most frequently found in human populations worldwide, is the most commonly identified agent of water-borne diseases in the United States (Feachem, et al., 1983). Waterborne giardiasis has been increasing in the U.S. with 95 outbreaks over the last 25 years. Over 60 percent of all *Giardia lamblia* infections are believed to be acquired from contaminated water. *Giardia lamblia* cysts are found in water contaminated by fecal material from infected humans and animals. *Giardia lamblia* forms an environmentally resistant cyst that allows the parasite to survive in surface water and treated drinking water. Surveys of *Giardia lamblia* cyst levels in various waters found that 26 to 43 percent of surface waters were contaminated with *Giardia lamblia* cysts ranging from 0.3 to 100 cysts per 100 liters. From pristine watersheds (those protected from all human activity), cyst levels were 0.6 to 5/100 l. In raw sewage, an average of 1,000,000 cysts/100 l are reported, with an approximate reduction of 99 percent after treatment (Rose, et al., 1991).

Ingestion of as few as 10 cysts can cause infection (Rendtorff and Holt, 1954). Infection was measured by the excretion of cysts, and illness was not determined. The ratio of illness to infection is highly variable. *Giardia lamblia* infections with no symptoms of illness may be as high as 39 percent for children under five years old and 76 percent for adults in certain populations (Craft, 1981; and Wolf, 1979; as reported in Rose, et al., 1991). At the same time,

symptomatic infections have been reported at a rate of 50 to 67 percent and as high as 91 percent in others (Veazie, et al., 1979, as reported in Rose, et al., 1991). In yet other groups, chronic giardiasis may develop in as many as 58 percent of an infected population.

Cryptosporidium. *Cryptosporidium*, an intestinal protozoan parasite, was first identified in 1907, but has been recognized to cause diarrheal disease in humans only since 1980. The first documented waterborne outbreak of cryptosporidiosis in humans occurred in the U.S. in 1985. In January 1988, EPA added *Cryptosporidium* to the Drinking Water Priority List.

The severe gastro-intestinal symptoms of the disease last an average of 12 days, and are self-limiting in people with normal immune function. Illness patterns vary with age, immune status, and variations in the virulence of *Cryptosporidium*. Young mammals are more susceptible. For AIDS and cancer patients, cryptosporidiosis can cause mortality. The oocyst (infective stage) dose necessary to cause an infection in humans is unknown, but may be low; in a primate study, two individuals became infected after exposure to only 10 oocysts (Miller, et al., 1986). No effective treatment for the disease exists.

Cryptosporidium is transmitted between humans and warm-blooded animals, including cats, dogs, cattle, goats, mice, pigs, rats, and sheep (Fayer and Ungar, 1986, as reported in Rose, 1991). *Cryptosporidium* from birds will not infect mammals, however. Common sources of *Cryptosporidium* in water are wildlife in a watershed, sewage discharges, and domestic animals (including runoff from grazing lands and dairies). For example, surface water running through cattle pastures can contain up to 6,000 oocysts per liter (Madore, et al., as reported in Peeters, et al., 1989).

The protozoan appears everywhere in the water environment. In a survey of waters in the western U.S., 91 percent of sewage samples, and 77 percent of rivers and 75 percent of lakes receiving wastewater discharges or agricultural pollution were found to contain oocysts at varying levels (Rose, 1988). Even 83 percent of pristine water supplies with no human activity in the watershed contained *Cryptosporidium* oocysts. Limited samples of treated drinking water reported 28 percent of the samples contained oocysts. The levels of oocysts in these waters are shown in Table II-3.

Cryptosporidium in drinking water resists chlorine disinfection. In addition, *Cryptosporidium* levels do not correlate well with indicator coliform bacteria levels, so meeting standards for coliforms and turbidity (a measure of the reduction of clarity of a water by suspended particles) may not be a sufficient measure of treatment reliability for removal of *Cryptosporidium*.

Normal levels of chlorine in drinking water have been shown to be ineffective for inactivating *Cryptosporidium*, even after 18 hours of contact. However, ozone and chlorine dioxide have been found to be more effective disinfectants (Peeters, et al., 1989). Sand filtration alone reduces but does not completely eliminate oocyst concentrations. Filtration with coagulation achieves greater removals.

TABLE II-3

***CRYPTOSPORIDIUM* OOCYSTS IN TYPICAL U.S. WATERS**

Water Source	Percent of Samples Positive for Oocysts	Average Oocysts per Liter (1)
Sewage, raw	91	4 - 5180
Sewage, treated	91	4 - 1297
Streams/Rivers	77	0.94, 1.09, 1.3
Lakes/Reservoirs	75	0.58, 0.91
Pristine Rivers	83	0.02, 0.08
Treated Drinking Water	28	0.002, 0.009

NOTES:
(1) Geometric means of samples.

SOURCE:
Rose, 1988.

Results of the State Project/Delta Water Pathogen Monitoring Project

The Metropolitan Water District of Southern California (MWD) conducted a pathogen monitoring survey of selected upstream and downstream sites in the SWP/Delta system from April 1992 through April 1993. The study evaluated the following sites that potentially affected pathogen loading in the water system, including:

- Greene's Landing, which represents water prior to entering the Delta, located 10 miles downstream from City of Sacramento wastewater discharges;
- Banks Pumping Plant (Milepost 3.3), #8 II-9: which monitors SWP water quality introduced at the Banks Pumping Plant;
- Delta-Mendota Canal (Milepost 67), which monitors water being transferred to the San Luis Canal at O'Neill Pumping Plant; and
- Aqueduct Checkpoint 29, which represents a site immediately above the southern California area.

A total of 48 samples was collected and analyzed for *Giardia lamblia* cysts, *Cryptosporidium* oocysts, enteric viruses and coliform bacteria. The percent positive and mean concentrations (cysts(ondocysts)/100 l) at each of the four stations for protozoans are shown in Table II-4.

TABLE II-4

PERCENT POSITIVE AND MEAN CONCENTRATION RANGE OF *GIARDIA LAMBLIA* CYSTS AND *CRYPTOSPORIDIUM* OOCYSTS AT FOUR SITES

	Giardia lamblia		*Cryptosporidium*	
	Percent Positive	Mean (Range) Conc.	Percent Positive	Mean (Range) Conc.
Greene's Landing	42	37 (8-82)	50	50 (5-132)
Banks Pumping Plant	0	0 (NA)	25	54 (32-70)
Delta-Mendota Canal	8	6 (6)	58	40 (9-92)
Aqueduct Checkpoint 29	0	0 (NA)	8	17 (17)

Means and ranges for total and fecal coliform bacteria concentrations at the four sites are shown in Table II-5.

TABLE II-5

MEAN CONCENTRATION AND RANGE FOR TOTAL COLIFORMS AND FECAL COLIFORMS AT FOUR SITES

	Coliform Concentration Mean (Range)	
	Total Coliforms (MPN/100 ml) (1)	Fecal Coliforms (MPN/100 ml) (1)
Greene's Landing	666 (140-1600)	24 (1-120)
Banks Pumping Plant	112 (11-500)	76 (0-310)
Delta-Mendota Canal	268 (13-1600)	16 (0-100)
Aqueduct Checkpoint 29	20 (2-50)	11 (0-99)

NOTE:
(1) Most probable number/100 milliliters.

In general, these results suggest that the highest coliform activity occurred at Greene's Landing and the lowest at Aqueduct Checkpoint 29. This relationship was also evidenced for *Giardia lamblia* and *Cryptosporidium*. Moreover, two of the three positive enteric virus samples were recovered at Greene's Landing. The source of the pathogens at Greene's Landing is not known, but may include effluent from upstream sewage treatment plants, release of sewage from boats, upstream recreational activity, and nonpoint fecal discharge.

MWD also conducted a pathogen monitoring survey of reservoirs in southern California receiving State Water Project water and Colorado River water. The results indicated that in both source waters, as measured downstream of Banks Pumping Plant, the levels of *Giardia lamblia* cysts

ranged from 0 to 1.5 cysts/100 l with a mean of 0.05 cysts/100 l. Cryptosporidium oocysts ranged from 0 to 1.8 oocysts/100 l with a mean of 0.18 oocysts/100 l.

Giardia lamblia and *Cryptosporidium* concentrations in SWP/Delta water were approximately six times lower than in surface water compared in nation-wide surveys (LeChevallier, et al., 1991).

Disinfection By-Products

Carcinogenicity is the health effect of principal concern for DBPs. Carcinogens are classified on the basis of the strength of health effects data that indicate the cancer-causing potential of chemicals. The highest rating is assigned when sufficient evidence exists that a compound causes cancer in humans. None of the currently known DBPs are so classified, because human health effects data are sparse. Therefore, the carcinogenic ratings for DBPs are based primarily on animal studies.

Cancer risks are expressed in terms of the numbers of cancers that might potentially occur as a result of contact with a chemical at a certain concentration over a lifetime of exposure. Thus, a "one in a million risk level of 1 μg/l" means that a chemical would be expected to cause no more than one case of cancer during lifetime exposure of one million people to the chemical at a concentration of 1 microgram per liter (μg/l).

The maximum contaminant level goal (MCLG) for carcinogens is automatically set at zero, and MCLs are set as close to that goal as is economically and technically feasible. Some people believe the "one in a million risk" level is sufficiently protective of human health. However, because the control of DBPs could involve a risk/risk trade off between chemical and microbial contaminants, the EPA typically attempts to regulate DBPs in the "one in a million" to "one in 10,000" risk level range.

It should also be noted that while ozone disinfection produces little haloacetic acids (HAAs) or THMs, ozone treatment may not be the best alternative to chlorine or chloramine (disinfectants), because in the presence of elevated levels of bromide, ozone disinfection tends to produce DBP in the form of bromate. Sacramento-San Joaquin Delta waters are naturally enriched with organic carbon and bromide and readily form brominated HAAs, which have not had risk levels determined as of this date. Hence, these compounds (DBPs and HAAs), as well as THMs, dichloroacetic acid, and bromide may be important carcinogens in the study area.

WATER QUALITY RULES AND REGULATIONS

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) (PL 99-339) was enacted by the U.S. Congress and signed into law by the President in 1974. Through the SDWA, the federal government gave EPA the authority to set standards for contaminants in drinking water supplies. The EPA was required to establish primary regulations for the control of contaminants that affect public health and secondary regulations for compounds that affect the taste or aesthetics of drinking water. The SDWA required the EPA to establish interim regulations immediately and then establish revised

final regulations following an extensive review of occurrence and toxicological data. Under the 1974 SDWA, the EPA established drinking water regulations for 23 constituents.

In 1975 the first series of National Interim Primary Drinking Water Regulations (NIPDWR) were established with updates between 1976 and 1981. However, progress in establishing new regulations for contaminants in drinking water in response to the SDWA was slow. As a result, extensive Amendments to the SDWA were signed into law in 1986.

The 1986 Amendments to the SDWA included a list of 83 contaminants to be regulated by the EPA. The Amendments also included a strict schedule for promulgation of regulations for the listed contaminants. For each contaminant, the EPA was required to establish either an MCL or a treatment technique (TT) to limit the presence of these compounds in drinking waters. EPA was also required to recommend a Best Available Technology (BAT) for removal of each contaminant during drinking water treatment. Systems do not have to install BAT to comply with an MCL. Systems that do not meet an MCL after installation of BAT, however, can receive a variance. If the EPA determines measuring the level of contaminant in water is not economically and technically feasible, the EPA can establish a treatment technique in lieu of an MCL.

The 1986 Amendments required the EPA to regulate the 83 contaminants within three years of promulgation and 25 additional contaminants every three years thereafter. The 1986 Amendments also required the EPA to establish criteria for filtration of surface water supplies and enforce all public water systems to provide disinfection. The Amendments also banned the use of lead pipes and solder and required water utilities to notify consumers of the health effects and sources of lead in drinking water and steps to reduce exposure.

The first step taken by the EPA to establish MCLs is to determine an MCLG for the target compound. The MCLG represents the concentration at which no known or anticipated adverse health effects occur, including an adequate margin of safety. MCLGs are established without consideration of analytical, treatability or economic issues. The MCLs are then set as close to the MCLG as is technically and economically feasible. In some cases, EPA has regulated contaminants by establishing a TT in lieu of an MCL.

The SDWA was reauthorized in August 1996. Again, substantial Amendments were passed to radically revise the law. The Amendments were developed to provide more flexibility, more state responsibility and more cooperative approaches. The law changes the standard setting procedure for drinking water and establishes a State Revolving Loan Fund to help public water systems to improve their facilities and ensure compliance with drinking water regulations.

The 1996 Amendments eliminated the requirement for EPA to establish 25 standards every three years. The EPA has 18 months, until February 6, 1998, to develop a list of high priority contaminants for possible regulation. These contaminants must have adverse health effects that are known or likely to occur at levels of public health concern. The EPA will select five contaminants every five years from the list and determine whether to regulate them. The regulations will be determined based on risk assessment and cost-benefit considerations and on minimizing overall risk. Regulations must be based on best available, peer reviewed science and data from best available methods.

Once a contaminant is determined to need regulation, the standard shall be promulgated within 18 months of the determination. The standard will take effect three years later. For each new regulation, the EPA is required to identify an affordable TT that will achieve compliance for small systems.

Under the provisions of the SDWA, the California Department of Health Services (DHS) has the primary enforcement responsibility (referred to as "primacy"). Title 22 of the California Administrative Code establishes DHS authority and stipulates drinking water quality and monitoring standards. To maintain primacy a state's drinking water regulations can be no less stringent than the federal standards (a state's regulations can be more stringent).

Current Regulations. As required under the SDWA and the extensive 1986 Amendments, many new regulations have recently been developed. These regulations are presented in Table II-6, and a general discussion of the requirements of each of the regulations follows.

TABLE II-6

CURRENT FEDERAL REGULATIONS

Regulation	Targeted Contaminants
NIPDWR (now NPDWR)	Health Contaminants
NSDWR	IOCs
NPDWR - THM Regulation	Trihalomethanes
Sodium and Corrosivity Requirements	Sodium and Corrosivity
Phase I Standards	VOCs
Surface Water Treatment Rule	Microbiological and Turbidity
Total Coliform Rule	Microbiological
Phase II Standards	VOCs, SOCs, and IOCs
Phase V Standards	VOCs, SOCs, and IOCs
Disinfectants/Disinfection By-Products (D/DBPs) Regulation	D/DBPs

National Primary Drinking Water Regulations (NPDWR)

Prior to the establishment of the EPA, the U.S. Public Health Service had established 22 preliminary drinking water standards, NIPDWR. MCLs were established for 22 inorganic chemicals, organic chemicals, physical parameters, radioactivity, and bacteriological factors. The primary standards, based on health effects to the consumer, are mandatory. These standards were adopted by the EPA.

Although the National Primary Drinking Water Regulations were originally adopted as "interim" standards, the 1986 Amendments to the SDWA removed the "interim" status of the NPDWR. Some standards have also been revised by recent EPA promulgations.

National Secondary Drinking Water Regulations

National Secondary Drinking Water Regulations (NSDWR) were established by the EPA in 1979 and 1991. These regulations are advisory in nature and are to be applied as determined by the states. These non-enforceable standards represent ". . . reasonable goals for drinking water quality. The states may establish higher or lower levels which may be appropriate dependent upon local conditions such as unavailability of alternate source waters or other compelling factors, provided that public health and welfare are not adversely affected (Code of Federal Regulations, 41 CFR 143.3)." Public notification is required if the secondary standard for fluoride of 2.0 mg/l is exceeded.

Trihalomethane Regulation

In 1979, the EPA published an amendment to the NPDWR, which established an MCL for THMs. The THM regulation applies to all public water systems serving populations greater than 10,000. Large sized utilities were required to begin monitoring for total trihalomethanes (TTHMs) in November 1980. The regulation established an MCL of 100 μg/l for TTHMs in the distribution system. TTHMs include the summation of chloroform, bromodichloromethane, dibromochloromethane, and bromoform concentrations. Because THMs can form after the application of the disinfectant, compliance with the MCL is based on a running annual average of at least four sampling points for each treatment plant with 25 percent of the samples taken at locations within the distribution system representing the maximum residence time of water in the system, and with at least 75 percent of the samples being collected from representative sites in the distribution system (considering number of persons served, sources of water, and treatment methods).

Sodium and Corrosivity Characteristics

Requirements for special monitoring of sodium and corrosivity characteristics were established by the EPA in 1980.

Phase I Regulations

The Phase I Regulations were finalized in by the EPA in July 1987 and compliance for large utilities was required by January 1989. The Phase I Regulations include MCLs for eight volative organic compounds (VOCs) and required utilities to collect quarterly samples from each source water supply for one year. These regulations included standards for trichloroethylene, carbon tetrachloride, 1,1,1-trichloroethane, vinyl chloride, 1,2-dichloroethane, benzene, 1,1-dichloroethylene, and para-dichlorobenzene. After one year, utilities could qualify for reduced monitoring based on the first year monitoring results (one sample every three years).

Along with the monitoring, reporting, and public notification requirements for the eight VOCs, the Phase I Regulations also included sampling requirements for unregulated contaminants. All public water systems were required to monitor for a minimum of 34 unregulated volatile organic contaminants; two additional contaminants if the system is determined vulnerable; and 15 additional contaminants at the state's discretion.

Surface Water Treatment Rule

The Surface Water Treatment Rule (SWTR) was promulgated by the EPA in June 1989 and large utilities were required to be in compliance with the Rule by June 1993. The SWTR was promulgated to control the levels of turbidity, *Giardia lamblia*, viruses, *Legionella*, and heterotrophic plate count bacteria in U.S. drinking waters. These five contaminants were included on the list of 83 contaminants to be regulated by the EPA according to the 1986 SDWA Amendments.

The SWTR requires all utilities utilizing a surface water supply or a ground water supply under the influence of a surface water supply, to provide adequate disinfection and under most conditions, to provide filtration. Exemptions from filtration of surface water supplies are provided in rare occasions where the source water supply meets extremely rigid requirements for water quality and the utility possesses control of the watershed. Each utility must also perform a watershed sanitary survey at least every five years, according to California state law.

Total Coliform Rule

The Total Coliform Rule (TCR) was promulgated by the EPA in June 1989 with compliance required 18 months after promulgation (January 1991). The State of California promulgated the Total Coliform Rule in January 1992 and the Rule went into effect on May 1, 1992. Under the TCR, utilities must submit a monitoring plan to the DHS for approval. The plan must provide for representative sampling of the distribution system (including all pressure zones and reservoir areas), describe any sample rotations proposed and include a statement that the sample collector has been trained. The total number of samples and frequency of sampling required is dependent on the population served by the utility. For all but the smallest utilities, weekly sampling is required.

Concerns were raised about the TCR because no variances or exemptions were allowed. Growth of biological films in the distribution system may lead to violations of the TCR even though there would be no demonstrable risk to public health. In August 1989, the American Water Works Association filed a legal petition to review the rule in the U.S. Court of Appeals. As a result of those activities, the EPA agreed to allow variances to systems not at risk for fecal or pathogenic contamination.

The EPA developed interim criteria as guidance to states seeking to identify systems that could operate under a variance without posing an unreasonable risk to health. In the future, the EPA will establish variance criteria. Public notification is required for a system operating under a variance.

Phase II Regulations

The Phase II Regulations were proposed in May 1989 and finalized in July 1991. Monitoring under the Phase II Regulations was required to begin in January 1993. The Phase II Regulations established MCLs for 39 contaminants (8 inorganic contaminants [IOCs], 10 VOCs, and 18 synthetic organic contaminants [SOCs], plus nitrate, nitrite, and total nitrate and nitrite) and treatment technique requirements for two additional treatment additives (polymers). Several of

the Phase II standards replaced NPDWR. In order to simplify the increasing number of monitoring requirements, the Standardized Monitoring Framework (SMF) was developed. The SMF is based on a nine-year cycle divided into three 3-year monitoring periods. Under the new monitoring schedule, initial monitoring, baseline monitoring, reduced monitoring, and increased monitoring requirements were established.

Phase V Regulations

The Phase V Regulations were proposed in July 1990 and finalized in July 1992. Systems with more than 150 service connections were required to begin monitoring for Phase V contaminants in the three-year compliance period on January 1, 1993. The SMF was incorporated into the Phase V Regulations with the first compliance period for large utilities beginning January 1994. Phase V established regulations for 23 contaminants, including 22 from the original list of 83 included in the 1986 SDWA Amendments (originally included a proposal for sulfate that was not included in the final Phase V regulations). The 23 Phase V contaminants include 5 IOCs, 3 VOCs, and 15 SOCs. The MCL for nickel, 0.1 mg/l, was remanded in February 1995 by the U.S. Court of Appeals for the District of Columbia Circuit. The EPA is required to reconsider the MCLG and the MCL, but no action has been taken yet.

Disinfectants/Disinfection By-Products Regulation

For several years, EPA has been developing information in anticipation of establishing a revised THM standard as well as standards for disinfectants and additional DBPs.

On September 15, 1992, EPA published a notice in the *Federal Register* that it intended to form a committee to develop the D/DBP regulation through a negotiated rule-making ("Reg-Neg") process. The *Federal Register* notice stated:

> EPA is considering establishing an Advisory Committee under the Federal Advisory Committee Act (FACA), and the Negotiated Rule-making Act of 1990. The Committee's purpose would be to negotiate National Primary Drinking Water Regulations for disinfectants and disinfection by-products under Section 1412 of the Safe Drinking Water Act (SDWA). The Committee would consist of representatives of parties that are substantially affected by the outcome of the proposed rule.
>
> This rule is intended to limit the concentrations of disinfectants and their by-products in United States drinking water systems. These limits conflict with other regulations, such as the Surface Water Treatment Rule, which establish minimum levels of disinfection needed to ensure that human exposure to microbiological contaminants is also limited. Therefore, in developing regulations for disinfection by-products, EPA needs to ensure that drinking water utilities can effectively provide treatment that controls concentrations of both disinfection by-products and microbiological organisms.

The membership of the committee included EPA and state regulators, water suppliers, health professionals, environmental organizations, consumer representatives, and other state and local

officials. The D/DBP Rule that was developed by the Reg-Neg committee was published by EPA in the *Federal Register* in July 1994.

CHAPTER III

ENVIRONMENTAL CONSEQUENCES

Chapter III

ENVIRONMENTAL CONSEQUENCES

This chapter compares the impacts of Alternatives 1 through 4 to the No-Action Alternative with respect to the drinking water quality in the Delta.

IMPACT ASSESSMENT METHODOLOGY

Impacts on drinking water quality for Delta water supplies are dependent upon changes in freshwater inflows, Delta exports, and upstream agricultural return flows during the summer and fall months. During the winter and spring months, high freshwater inflows usually reduce the salinity and concentrations of disinfection by-product precursors. Relationships developed based on historical salinity and flow measurements were used to estimate changes in salinity levels at Collinsville and in the San Joaquin River at Vernalis. These changes are discussed in detail in the Surface Water Supplies and Facilities Operations technical appendix and in Attachment B of the Fisheries technical appendix.

The PEIS does not include an analysis of hydrodynamic conditions in the Delta, and therefore does not provide a detailed assessment of salinity or other water quality parameters in the vicinity of Delta export facilities. However, analysis of salinity was conducted for surface water operations, vegetation and wildlife, and fishery resources as described in the respective appendices. The results of these analyses provide a broad indication of average monthly salinity conditions at Delta boundaries. This information was used to provide a general indication of the potential impacts to TDS levels in the Delta for the purposes of this programmatic evaluation. It is recognized that major drinking water intake facilities are located at multiple locations throughout the Delta, and that detailed water quality evaluations may be required as part of future site specific analyses.

NO-ACTION ALTERNATIVE

Under the No-Action Alternative, water quality conditions in the Delta would be governed by the Bay-Delta Plan Accord and D-1422. In general, salinity concentrations would be reduced in some months as compared to recent Delta conditions described in the Affected Environment, particularly during dry years. Agricultural return flow quantities would not change significantly from conditions described in the Affected Environment. However, agricultural return flow quality would improve by the year 2022, due to the recent or pending implementation of more stringent water quality requirements for point and non-point discharges. Also in the No-Action Alternative, the operations of New Melones Reservoir would attempt to meet all requirements of D-1422 provisions before releases would be made for other purposes.

ALTERNATIVE 1

Under Alternative 1, inflow to the Delta from the Sacramento River system would be slightly less than under the No-Action Alternative, primarily as a result of reduced diversions from the Trinity River Basin. Delta exports would be reduced in February through September due to reduced Trinity diversions and (b)(2) Water Management. The overall change in Delta outflow would be relatively small under Alternative 1 as compared to the No-Action Alternative. As a result of the operations under Alternative 1, salinity in the Delta at Collinsville would be similar to conditions under the No-Action Alternative.

During some dry years, salinity in the San Joaquin River at Vernalis would increase, as compared to concentrations under the No-Action Alternative. This would occur due to increased deliveries to and return flows from the San Luis Complex refuges. In addition, the management of (b)(2) water on the Stanislaus River would lower storage conditions in New Melones Reservoir, and would result in the imposition of the maximum water quality release threshold more frequently. During those years, less water would be released for water quality maintenance at Vernalis than under the No-Action Alternative, and the salinity concentration would be higher.

ALTERNATIVE 2

Under Alternative 2, inflow to the Delta from the Sacramento River system would be similar to conditions under Alternative 1, and would be slightly less than under the No-Action Alternative. Total irrigated acreage upstream of the Delta (including the San Joaquin River, Tulare Lake, and Sacramento River regions) would be reduced by less than 2 percent under this alternative as compared to the No-Action Alternative. Most of this change would be related to reductions in acreage of pasture and hay, rice, cotton, and other field crops such as sugar beets. This reduction in irrigated acreage would result in reduced return flows, which could reduce concentrations of DBP precursors.

The delivery of Level 4 water supplies to wildlife refuges would increase the return flows from the San Luis Complex refuges as compared to the No-Action Alternative and Alternative 1, particularly in the early spring. The release of up to 170,000 acre-feet of acquired water on the Merced, Tuolumne, and Stanislaus rivers (combined) for instream flows and Delta outflow, however, would increase instream flows on these rivers and on the San Joaquin River. This increased flow would result in lower salinity concentrations on the San Joaquin River at Vernalis, and a slight increase in Delta inflow.

As a result of the operations under Alternative 2, salinity in the Delta at Collinsville would be similar to conditions under the No-Action Alternative. Therefore, based upon the minor changes in Delta inflows and salinity, and minor reductions in irrigated acres and associated return flows, Delta water quality for drinking water uses would be similar or slightly improved in Alternative 2 as compared to the No-Action Alternative.

ALTERNATIVE 3

Under Alternative 3, inflow to the Delta from the Sacramento River system would be similar to conditions under Alternative 1, and would be slightly less than under the No-Action Alternative. Total irrigated acreage upstream of the Delta (including the San Joaquin River, Tulare Lake, and Sacramento River regions) would be reduced by less than 4 percent under this alternative as compared to the No-Action Alternative. Most of this change would be related to reductions in acreage of pasture and hay, rice, cotton, and other field crops such as sugar beets. This reduction in irrigated acreage would result in reduced return flows, which could reduce concentrations of DBP precursors.

The delivery of Level 4 water supplies to wildlife refuges would increase the return flows from the San Luis Complex refuges as in Alternative 2, particularly in the early spring. The release of up to nearly 800,000 acre-feet of acquired water on the Merced, Tuolumne, Stanislaus, Calaveras, Mokelumne, and Yuba rivers (combined) for instream flows, however, would increase instream flows on these rivers and on the San Joaquin River. This increased flow would result in lower salinity concentrations on the San Joaquin River at Vernalis, and an increase in total Delta inflow of about 400,000 acre-feet on an average annual basis, as compared to the No-Action Alternative.

Under Alternative 3, acquired water may be exported by CVP and SWP facilities during times when the Delta is in an excess condition. As a result, the net change in Delta outflow under Alternative 3, as compared to the No-Action Alternative, would be an increase of approximately 200,000 acre-feet on an average annual basis. Therefore, based upon the changes in Delta inflows and salinity, minor reductions in irrigated acres and associated return flows, and increased Delta outflow, it is anticipated that Delta water quality for drinking water uses would be similar or slightly improved in Alternative 3 as compared to the No-Action Alternative.

ALTERNATIVE 4

Alternative 4 includes the same water management and water acquisition actions as those described under Alternative 3. Therefore, Delta inflow from all sources would be similar to conditions described under Alterative 3. However, under Alternative 4, the CVP and SWP would not be allowed to export acquired water. As a result of this operation, Delta outflow under Alternative 4 would be approximately 700,000 acre-feet greater than under the No-Action Alternative, on an average annual basis.

Therefore, based upon the increase in Delta inflows, and minor reductions in irrigated acres and associated return flows, Delta water quality for drinking water uses would be similar or slightly improved under Alternative 4 as compared to the No-Action Alternative.

CHAPTER IV

BIBLIOGRAPHY

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BIBLIOGRAPHY

Bay-Delta Oversight Council, June 1993, Draft Briefing Paper on Delta Water Quality for Drinking Water and Agricultural Uses, 170 p.

Brown and Caldwell Consulting Engineers, May 1989, Delta Drinking Water Quality Study: Report prepared for nine California urban water agencies, 160 p. plus appendices.

California Department of Health Services, Office of Drinking Water, May 15, 1991, Surface Water Treatment, Staff Guidance Manual.

California Department of Water Resources, May 1956, Investigation of the Sacramento-San Joaquin Delta, Report No.2, Water Supply and Water Utilization on Medford Island, 88 p.

California Department of Water Resources, July 1956, Investigation of the Sacramento-San Joaquin Delta, Report No. 4, Quantity and Quality of Water Applied to and Drained from the Delta Lowlands, 62 p.

California Department of Water Resources, Panel Report for, December 31, 1982, Public Health Aspects of Sacramento-San Joaquin Delta Water Supplies, 59 p.

California Department of Water Resources, Central District, May 1985, Interagency Delta Health Aspects Monitoring Program, Project Report, 84 p.

California Department of Water Resources, October 1987, Progress Report 7 for the Interagency Delta Health Aspects Monitoring Program, 65 p.

California Department of Water Resources, Central District, Interagency Delta Health Aspects Monitoring Program, August 1989, The Delta as a Source of Drinking Water, Monitoring Results - 1983 to 1987. 150 p.

California Department of Water Resources, Division of Local Assistance, June 1990, Delta Island Drainage Investigation Report of the Interagency Delta Health Aspects Monitoring Program, A Summary of Observations During Consecutive Dry Year Conditions, Water Years 1987 and 1988, 110 p. plus appendices.

California Department of Water Resources, 1993, Sacramento San Joaquin Delta Atlas, 122p.

California State Water Resources Control Board, Department of Health Services and Department of Water Resources, October 1991, Delta Water Quality: A Report to the Legislature on Trihalomethanes and the Quality of Drinking Water Available From the Sacramento-San Joaquin Delta, 46 p.

_____, 1994, Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary, Draft Environmental Report.

_____, 1994, Appendix to Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary, Draft Environmental Report.

Contra Costa Water District, May 1987, Los Vaqueros/Kellogg Project, Effect of Reservoir Impoundment on Water Quality.

Contra Costa Water District, April 1993, Briefing Paper for Bay Delta Oversight Council Meeting of April 16, 1993.

Contra Costa Water District and U.S. Bureau of Reclamation, September 1993, Final Stage 2 Environmental Impact Report/Environmental Impact Statement for the Los Vaqueros Project.

DeWolf, G., P. Murin, J. Jarvis, and M. Kelly, 1984, The Cost Digest: Cost Summaries of Selected Environmental Control Technologies: EPA-600/8-84-010, October 1984, 92 p.

DWR, See California Department of Water Resources.

Feachem, R.G., D.H. Bradley, H. Garelick, and D. D. Mara, 1983, Sanitation and Disease Health Aspects of Excreta and Wastewater Management: New York, John Wiley & Sons.

James M. Montgomery, Consulting Engineers, Inc., November 1980, Volume I Water Quality Study, Volume II Water Treatment Study, for Contra Costa Water District.

James M. Montgomery, Consulting Engineers, Inc., 1982, Clifton Court Water Quality, prepared for Alameda County Water District, Contra Costa Water District, Santa Clara Valley Water District, and Zone 7 of the Alameda County Flood Control and Water Conservation District.

James M. Montgomery, Consulting Engineers, Inc., 1985, Water Quality Study, Volumes 1 - 4, prepared for Contra Costa Water District and East Bay Municipal Utility District.

James M. Montgomery, Consulting Engineers, Inc.and Metropolitan Water District of Southern California, November 1989, Final Report for Disinfection By-Products in United States Drinking Waters, prepared for the USEPA and Association of Metropolitan Water Agencies.

James M. Montgomery, Consulting Engineers, Inc., January 1992, Final Report for Effect of Coagulation and Ozonation on the Formation of Disinfection By-Products, prepared for the American Water Works Association.

Krock, H.-J., and D.T. Mason, University of California, Berkeley, October 1971, Bioassays of Lower Trophic Levels, Volume VI of a Study of Toxicity and Biostimulation in San

Francisco Bay Delta Waters, prepared for the State Water Resources Control Board, Sanitary Engineering Research Laboratory SERL Report No. 71-8, 123 p.

LeChevallier, M.W., W.D. Norton, and R.G. Lee, 1991, Occurrence of *Giardia* and *Cryptosporidium* spp. in Surface Waters: Applied Environmental Microbiology Vol.57, pg. 2610.

Metropolitan Water District of Southern California, 1993, Impacts of Delta Water Quality on the Metropolitan Water District of Southern California, Briefing Paper for the Bay Delta Oversight Council.

Ongerth, Jerry, 1989, Giardia Cyst Concentrations in River Water: Journal AWWA, Vol. 81, No.9, pp. 81-86.

Peeters, J.E., E.A. Mazas, W.J Masschelein, I. Villacorta Martinez de Maturana, E. Debacker, 1989, Effect of Disinfection of Drinking Water with Ozone or Chlorine Dioxide on Survival of *Cryptosporidium parvum* Oocysts: Applied and Environmental Microbiology, pp. 1519-1522.

RCG/Hagler, Bailly, Inc. and Kennedy/Jenks Consultants, 1993, An Evaluation of the Federal Drinking Water Regulatory Program Under the Safe Drinking Water Act as Amended in 1986, Final Report: Prepared for American Water Works Association, safe Drinking Water Act Technical Advisory Group.

Rose, J., 1988, Occurrence and Significance of Cryptosporidium in Water: Journal AWWA, pp. 53-58.

Rose, J.B., C.P. Gerba, and W. Jakubowski, 1991, Survey of Potable Water Supplies for *Cryptosporidium* and *Giardia*: Environmental Science and Technology, 25: 1393.

Rose, J.B., C.N. Haas, and S. Regli, 1991, Risk Assessment and Control of Waterborne Giardiasis: American Journal of Public Health Vol. 81, No.6, pp. 709-713.

Santa Clara Valley Water District, April 1993, Briefing Paper for the Bay Delta Oversight Council, April 16, 1993.

U.S. Environmental Protection Agency, Office of Water, August 1993, Status of DBP Regulatory Negotiation: EPA 811/F-93-001.

U.S. Environmental Protection Agency, Office of Water, September 1993, Technical and Economic Capacity of States and Public Water Systems to Implement Drinking Water Regulations, Report to Congress: EPA 810-R-93-001, 127 p. plus appendices.

U.S. General Accounting Office, June 1987, Water Quality: Pollution of San Francisco Bay and the Sacramento-San Joaquin Delta, Fact Sheet for the Honorable Vic Fazio, House of Representatives, GAO/RCED-87—156FS, 39 p.

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